

Fig. 5 a (Exp. 15). The periosteum was curetted and afterwards repeated injections of marrow extract were made in this place. The new osteoid tissue formation was more ample than in Fig. 5 b. In the skigram a periosteal calcareous deposit was visible.

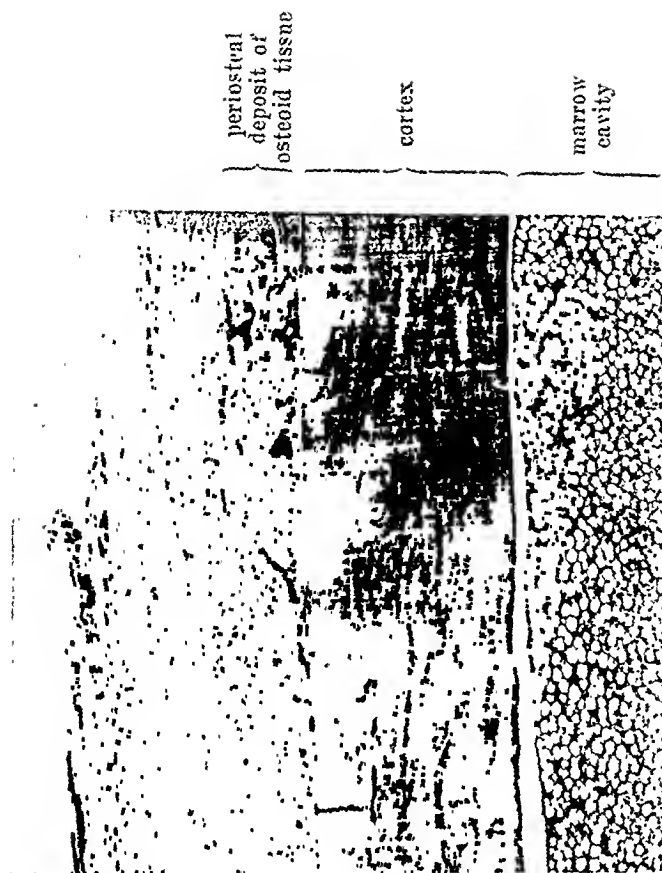


Fig. 5 b (Exp. 15). Repeated injections of marrow extract beneath the intact periosteum. Less osteoid tissue formation than in Fig. 5 a. In the skigram no calcareous deposit was visible.

# ACTA CHIRURGICA SCANDINAVICA

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SUB TITULO

NORDISKT MEDICINSKT ARKIV

CONDIDIT MDCCCLXIX AXEL KEY

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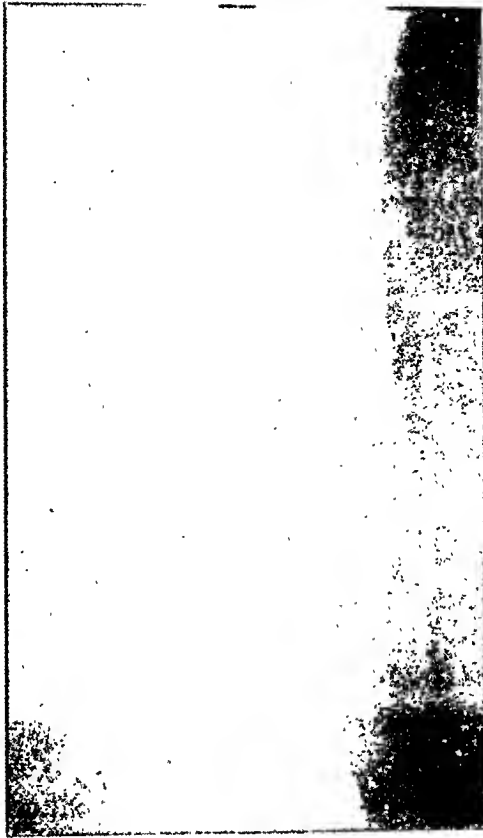


Fig. 11.



Fig. 12.



117

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*Exp. 4.* In the lower portion of the left ulna not only the epiphys. and epiphysial cartilage were extirpated, but in addition  $\frac{1}{2}$  cm. of the adjacent part of the diaphysis was resected extraperiosteally. A hole was drilled into the ulna diaphysis above the site of resection, and a piece of wire (stainless steel) was inserted. In the skiagram made as early as 3 days after operation the distance between the lower end of the resection and the wire placed higher up in the diaphysis was 6 mm. After 1 month the distance was 10 mm., and after 1 further month, when the animal was killed, 14 mm. From the lower end of the ulna accordingly an increase of 8 mm. had taken place. The newly formed part of the ulna was not of the same thickness as the ulna diaphysis, having instead the shape of a cone pointing downward (Fig. 4).

Immediately  
after operation

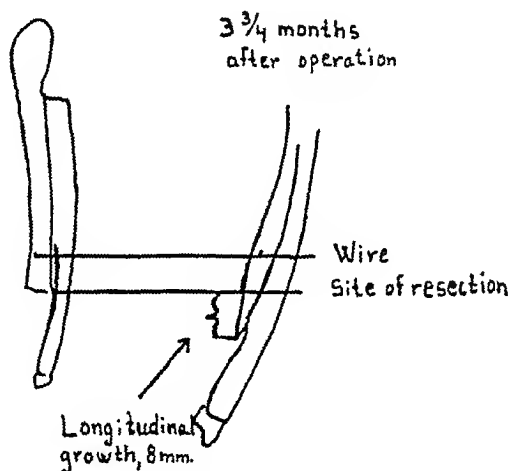


Fig. 4 (Exp. 4).

*Exp. 5.* In the lower part of the left ulna the epiphysis and epiphysial cartilage as well as 13 mm. of the lower end of the diaphysis were extirpated extraperiosteally. A wire was inserted into the diaphysis immediately above the end of the resection. In skiagrams taken as early as 3 days after the operation the wire was seen to be situated 3 to 4 mm. above the end of the resection in the diaphysis. After 1 month the lower end of the ulna had increased its length by 17 mm., and after 1 further month by 22 mm. The newly formed portion of the ulna was markedly thinner than the ulna diaphysis (Fig. 5).

*Exp. 6.* Resection of the lowermost part of the left ulna including the epiphysis, the epiphysial cartilage and  $\frac{1}{2}$  cm. of the lower portion of the diaphysis (extraperiosteally).  $\frac{1}{2}$  cm. above the end of the resection a hole was drilled through the ulna diaphysis, and a piece of wire (stainless steel) was inserted. By a skiagram made 2 months later it was ascertained that new bone, extending into a thin osseous tongue,

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(Chef: Dr. KURT STENPORT.)

## Eine Modifikation der Nicola'schen Operationsmethode bei habitueller Schultergelenkluxation.

Von:

TORSTEN JERRE.

Die habituelle Schultergelenkluxation hat seit langem das grosse Interesse der Chirurgen und Orthopäden erweckt. Ausser durch rein operative Therapie, die die Behandlung der habituellen Schultergelenkluxation völlig beherrscht, hat man auch versucht, die Krankheit durch orthopädische Bandagen hintanzuhalten, von solcher Konstruktion, dass diejenige Bewegung im Schultergelenk verhindert wird, bei der die Ausrenkung einzutreffen pflegt, also vor allem die Abduktion. Ausserdem geht man darauf aus, bei der gewöhnlichen, vorderen Schultergelenkluxation durch die Bandage der vorderen Partie des Schultergelenks eine Stütze zu verschaffen. Jedoch ist das invalidisierende Moment bei solch einer Bandagenbehandlung überaus ausgesprochen, und sie dürfte heutzutage völlig verlassen worden sein, vielleicht mit Ausnahme derjenigen Fälle, wo lästige Beschwerden vorliegen gleichzeitig mit strengen Kontraindikationen auch gegen einen verhältnismässig leichten operativen Eingriff.

Von operativen Methoden ist eine Unzahl beschrieben, von denen manche nur geschichtliches Interesse besitzen. So hat man versucht, mit den wiederholten Ausrenkungen durch so verschiedene Eingriffe zurecht zu kommen, wie Resektion des Caput humeri, Arthrodesse im Schultergelenk, Kapsulorhaphie nach verschiedenen Methoden, Vertiefen der Fossa glenoidalis durch Aufmeisseln, Fixation des Humeruskopfes an das Akromion, den Processus coracoideus oder den oberen Rand der Cavitas glenoidalis mittels Metalldraht, Fascia lata, der langen Peroneussehne, der langen oder der kurzen Sehne des Bizepskopfes, Hebung des

mité inférieure de l'os, encore que de façon moins considérable que du côté non opéré. Lorsqu'on réséqua en outre une partie de la moitié distale de la diaphyse cubitale par voie extra-périostée, la longueur s'accrut aussi à partir du niveau de la résection, bien que la partie néoformée du cubitus fut considérablement plus mince que le reste de la diaphyse. Ainsi donc, la croissance en longueur des diaphyses peut avoir lieu même sans cartilage de conjugaison.

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vorderen Randes der Fossa glenoidalis mittels Knochentransplantat, Os purum, oder durch Verlängerungsoperationen am Processus coracoidens, verschiedene Muskeltransplantationen, Vernähung des Labrum glenoidale oder der Kapsel direkt mit dem vorderen Knochenrande der Cavitas glenoidalis durch in letzteren gebohrte Löcher. Näher auf alle diese im Schrifttum vorgeschlagenen Operationsmethoden einzugehen, liegt völlig ansserhalb des Rahmens für diesen Aufsatz. Es sei nur kurz diejenige Operationsmethode beschrieben, die gewöhnlich als NICOLA'sche Methode bezeichnet wird, sowie Modifikationen derselben.

Im Jahre 1927 beschrieb HEYMANOWITSCH bei der habituellen Schultergelenkluxation eine Operationsmethode, die er in zwei verschiedenen Modifikationen ausgearbeitet hatte. Nach der ersten wird die Sehne des langen Bizepskopfes freipräpariert und möglichst nahe an ihrem Ursprung durchtrennt. Darauf wird durch die laterale Partie des Humerus ein Kanal gebohrt, in der Richtung von vorn unten nach hinten oben. Durch diesen Kanal wird die abgeschnittene Sehne gezogen und an das Akromion befestigt. Nach der anderen Methode wird gleichfalls die Sehne des langen Bizepskopfes freipräpariert. In diesem Falle wird jedoch die Sehne auf der Höhe des Collum chirurgicum durchschnitten. Darauf wird durch den Humeruskopf in solcher Weise ein Kanal gebohrt, dass die obere Mündung des Kanals in der Nähe des Ursprungs der Sehne am oberen Rande der Fossa glenoidalis zu liegen kommt. Die proximale Partie der Sehne wird nun von oben nach unten durch diesen Kanal geführt und wieder mit der distalen Partie vernäht.

Im Jahre 1929 beschrieb NICOLA, ohne HEYMANOWITSCH zu erwähnen, eine Methode, die sich nur in unbedeutenden Einzelheiten von der zweiten HEYMANOWITSCH'schen Modifikation unterscheidet. Er freipräpariert gleichfalls die Sehne des langen Bizepskopfes bis hinauf an ihren Ursprung und durchtrennt sie  $2\frac{1}{2}$  cm unterhalb des Ligamentum transversum humeri. (Das Ligamentum transversum humeri erstreckt sich vom Tuberculum majus zum Tuberculum minus und überdacht den Sinus intertubercularis.) Darauf wird durch den Humeruskopf ein Kanal gebohrt von der Gegend gleich unterhalb des Ligamentum transversum humeri aus und in solcher Richtung, dass seine obere Mündung im Zentrum der Gelenkfläche des Humeruskopfes zu liegen kommt. Die proximale Partie der durchtrennten Sehne wird nun von oben nach unten durch diesen Kanal geführt und

therefore, inevitably certain weaknesses (JOHNSTONE and HENDERSON, SEBRECHTS). The method is, however, still being tried out.

Pathological-physiological examinations have demonstrated the mechanism for the effect of spinal anaesthesia on respiration and circulation. The earlier opinion that anaesthesia by means of direct influence on the centres in the brain and the medulla oblongata was the cause of such disturbances has been disproved. Anaesthesia affects the nerves and not the above-mentioned centres. It has now been demonstrated that the fall in blood-pressure is caused by vaso-constrictor paralysis through blocking of the anterior nerve roots. As long as large areas of the body still remain outside the anaesthetic zone, the organism can compensate the fall of blood pressure by the carotid sinus mechanism. The larger the field of the anaesthetic, however, the smaller are the possibilities of this compensation (KOSTER and KASMAN, JOHNSTONE and HENDERSON, MATOLSCY, SEBRECHTS, SCHUBERTH, FERGUSON and WATKINS, PSACHAROPULO).

Respiration is affected only to the degree that the inter-costal muscles and the phrenic nerves are included in the anaesthetic. Anaesthesia to Th 1 scarcely affects the oxygen saturation of the blood (SCHUBERTH). It is only when the level of the phrenic nerves is reached that more severe respiratory embarrassment occurs.

The improvements which have thus been effected have had the result that spinal anaesthesia has in many hospitals become the normal method of inducing anaesthesia in all major operations in the abdomen and the lower extremities.

As an example of this development it can be recorded that of the total number of anaesthetics, spinal anaesthesia constituted the following percentages:

	1940	1943
Surgical Clinic of the Caroline Hospital . . . . .	20 %	40 %
Surgical Clinic of the Serafimer Hospital . . . . .	approx. the same frequency (Gordh)	
Surgical Clinic of the University of Uppsala . . .	13 %	14 %
Surgical Clinic of the University of Lund . . . . .	8 %	23 %
Surgical depts. of Maria Hospital and Södersjukhuset . . . . .	12 %	30 %

The increase in the majority of cases has been at the expense of inhalation anaesthesia.

Even if modern spinal anaesthesia has meant great improvements in this field, this circumstance should not hide the fact

wieder mit der distalen Partie vernäht. Darauf wird die proximale Partie der Sehne gedehnt, und unter Dehnung wird sie mit Nähten an das Periost an der unteren Mündung des Kanals befestigt und zwar um den Zug an der Nahtstelle zwischen proximaler und distaler Partie der Sehne auszuschalten.

Diese hier zuletzt beschriebene Operationsmethode wird im Schrifttum manchmal als HEYMANOWITSCH-NICOLA'sche Operationsmethode bezeichnet, gewöhnlich jedoch nur als NICOLA'sche Methode. Die Methode, die grosse Ausbreitung gewonnen hat und von Chirurgen und Orthopäden fleissig gebraucht wird, ist in recht vielartiger Weise modifiziert worden.

So beschrieb WAHL im Jahre 1931 eine Modifikation. Er freipräpariert die Sehne des langen Bizepskopfes, durchschneidet sie 2—3 Fingerbreit unterhalb des Tuberculum majus, vernäht die distale Partie der Sehne mit dem Periost im Sulcus intertubercularis und bohrt darauf einen Kanal von der oberen Partie des Sulcus intertubercularis aus durch das Tuberculum majus in nach hinten-abwärts verlaufender Richtung. Durch diesen Kanal wird die proximale Partie der Sehne gezogen, über die untere Kante geklappt und an der Umgebung befestigt. WAHL betont, dass durch diese Modifikation eine breite Eröffnung des Gelenks vermieden wird, welche bei der NICOLA'schen Methode erforderlich ist mit der daraus folgenden Infektionsgefahr. Ferner ist er der Ansicht, dass man bei der NICOLA'schen Methode wegen der bei der Operation gesetzten Schädigung des Gelenkknorpels nicht völlig von der Gefahr einer später auftretenden Arthrosis deformans des Schultergelenks absehen kann. Ausserdem betont er, dass diese Modifikation einen bedeutend kleineren Eingriff darstellt und technisch viel leichter ist.

Im Jahre 1933 schlug HOBART eine andere Richtung des Kanals durch den Humeruskopf vor. Er bohrt diesen Kanal durch die laterale Partie des Humeruskopfes in solcher Richtung, dass die distale Öffnung gerade unter dem Ligamentum transversum humeri zu liegen kommt und die proximale am oberen Ende des Sulcus intertubercularis. Durch diese veränderte Richtung des Kanals durch den Humeruskopf meint er einen normaleren anatomischen Verlauf der Sehne ohne scharfe Winkel zu erzielen sowie Traumatisierung der Sehne zwischen Caput humeri und Fossa glenoidalis zu vermeiden.

Im Jahre 1933 veröffentlichte ROBERTS eine andere Modifikation. Er freipräpariert gleichfalls die Sehne des langen Bizepskop-



Fig. 3. Case 3. Scars of primary tuberculosis ulcers.  $\times 8$ .



Fig. 4. Case 4. Granulation tissue covered with regenerated epithelium from irregular crypts.  $\times 100$ .

INBERG: Cicatrizing Intestinal Tuberculosis.



fes, hebt sie aus dem Sulcus intertubercularis hoch und führt sie zur Seite. In der oberen Fortsetzung des Sulcus intertubercularis wird eine Rinne aufwärts in das Gebiet des Caput humeri gemeißelt, so dass der Sulcus intertubercularis nach oben verlängert wird. Die Sehne wird darauf wieder in ihre alte Lage gebracht. Das Ligamentum transversum humeri wird zusammengeñäht und mit diesen Nähten auch die Sehne gefasst.

Im Jahre 1934 erwähnt NICOLA anlässlich einer Nachuntersuchung wieder seine Methode. In dieser Beschreibung der Methodik gibt er an, dass die Richtung des Bohrkanals so sein muss, dass die innere Mündung »einen halben bis drei viertel Zoll« vom Rande des Gelenkknorpels des Caput humeri zu liegen kommt.

Im Jahre 1935 betonte HOBART, dass die Operation nach NICOLA nicht immer voll befriedigende Resultate gegeben habe. Er beschreibt jetzt ein Verfahren, bei dem zwei Operationsmethoden kombiniert wurden. Zuerst nimmt er die oben erwähnte, von ihm selber eingeführte Modifikation der NICOLA'schen Methode vor und in direktem Anschluss hieran eine Muskelplastik nach CLAIRMONT-EHRLICH.

Im Jahre 1935 machte RUPP die Ansicht geltend, dass die Sehne des langen Bizepskopfes bei Muskelkontraktionen des Bizeps auf den Humeruskopf drücke und bei gewissen Bewegungen die Luxation verursache. Um der Kraftwirkung einen anderen Ausgangspunkt zu geben, vernäht er die Sehne mit dem Periost im Sulcus intertubercularis auf der Höhe der beiden Tuberkeln.

Im Jahre 1940 beschrieb JANEK eine Methode, die von FREJKA seit 1933 verwendet worden war und der oben erwähnten, von ROBERTS beschriebenen ähnlich ist. FREJKA präpariert die Sehne des langen Bizepskopfes frei. Darauf vertieft er den Sulcus intertubercularis und verlängert ihn nach oben. In die durch die Aufmeisselung erhaltene lange, tiefe Rinne legt er die freipräparierte Sehne, verkürzt sie distal vom Sulcus intertubercularis und befestigt sie auch hier an das Periost. Darauf deckt er die in die Tiefe gelegte Sehne mit den bei der Aufmeisselung des Sulcus intertubercularis erhaltenen Knochenspänen. Als Vorzüge seiner Modifikation gegenüber der Originalmethode NICOLA's hebt FREJKA folgendes hervor. Das Vertiefen des Sulcus intertubercularis ist technisch leichter als das Bohren eines Kanals durch den Humeruskopf. Die Schädigung des Gelenkknorpels ist geringer. Die Gelenkkapsel braucht nicht so breit eröffnet zu wer-

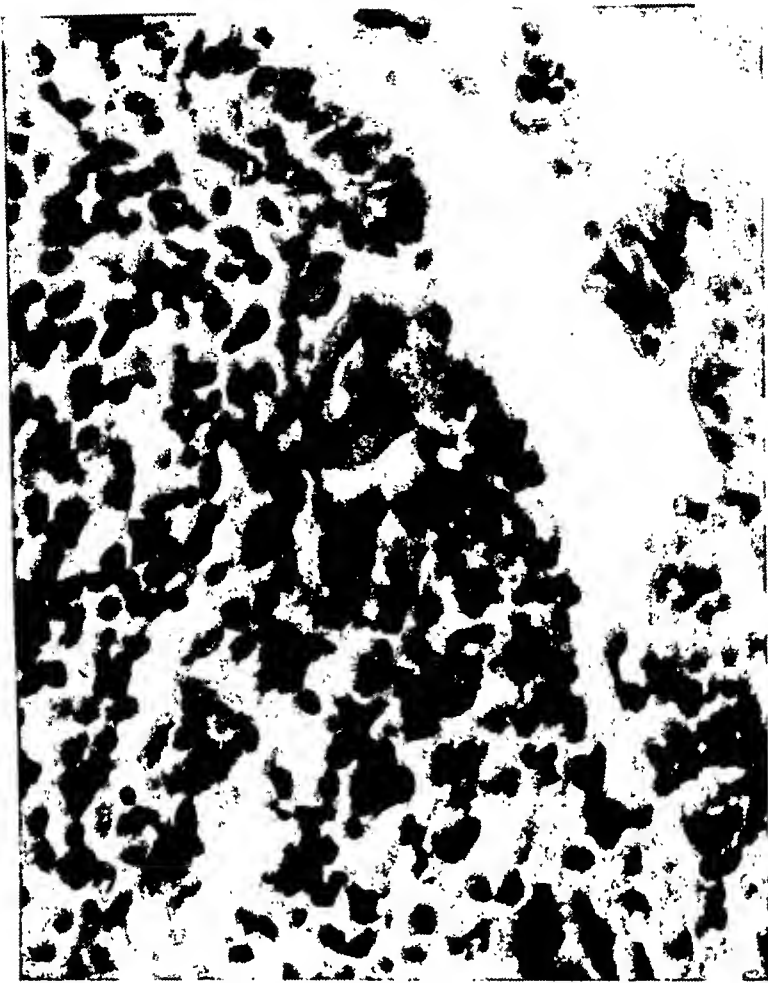


Fig. 7. Case 4. Early lesion in ileum.  $\times 450$ .



Fig. 8. Case 4. Secondary tuberculous ulcer from ileum.  $\times 8$ .

INBERG: Cicatrizing Intestinal Tuberculosis.

den. Die Sehne des langen Bizepskopfes wird nicht durchtrennt. Aus diesem Grunde liegt nicht, wie bei der Methode NICOLA's, die Gefahr vor, dass die Sehnennähte versagen und die proximale Partie der Sehne aus dem Kanal durch den Humeruskopf herausgleitet.

Im Jahre 1941 veröffentlichte AHLBERG eine Methode, die, wie er angibt, KJELL BERGMAN im Jahre 1934 zu verwenden begonnen hatte. Die Sehne des langen Bizepskopfes wird freipräpariert und gleich unterhalb des Tuberculum majus durchtrennt. Die distale Partie der Sehne wird im Sulcus intertubercularis unter einem aufgemeisselten Knochenlappen befestigt. Die proximale Partie wird medial vom Tuberculum minus geführt und hier unter einem Knochenlappen befestigt, der im Tuberculum minus aufgemeisselt worden ist. AHLBERG betont, dass die Operationsmethode NICOLA's einen ernsten Eingriff darstellt, breite Eröffnung des Gelenks erfordert und den Gelenkknorpel nicht intakt lässt, weshalb er die KJELL BERGMAN'sche Modifikation als einen schonenderen Eingriff ansieht. Die der NICOLA'schen Operationsmethode anhaftende Schwäche, dass die Sehne durchtrennt wird, ist bei dieser Methodik vermindert, indem die Sehne unter aufgemeisselten Knochenlappen fixiert wird.

Im Jahre 1945 erwähnt CAMITZ eine weitere Modifikation. Die Sehne des langen Bizepskopfes wird freipräpariert. Mit einem Meissel wird eine Rinne erzeugt »an die Basis der Tuberculum minus und unter demselben, so gross, dass die Bizepssehne in die in dieser Weise entstandene Rinne gebracht werden kann. Die Sehne wird daselbst teils mittels Katgut, teils mit ein—zwei Seidensuturen fixiert«. In einer Aussprache im Schwedischen chirurgischen Verein im Jahre 1942 erwähnt CAMITZ, dass er eine Methode verwendet, »die ganz einfach darin besteht, dass die lange Sehne des Bizeps nach Freilegung des Gelenks völlig gelöst wird bis hinauf zu ihrem Ursprung an der Tuberositas supraglenoidalis scapulae und so weit nach abwärts, dass man die Sehne über das Tuberculum majus ziehen und hier in einer Rinne an und unter dem Tuberculum fixieren kann«.

Im Jahre 1943 begann STENPORT in dem Krüppelanstalt in Hälsingborg bei vorderen habituellen Schultergelenkluxationen folgende Methode zu verwenden. Äthernarkose. Der Arm wird in 90-gradiger Abduktion auf einen Armtisch gebracht. Unter der Schulter ein kleines Kissen. Der Hautschnitt erstreckt sich vom Akromioklavikulargelenk aus am Oberarm den vorderen Rand

Tabelle 4.

Krankenhaus	Jahr	Operiert unter der Rubrik Susp. Append. ac.	Appendektomiert unter der Rubrik:		
			Lympha- denitis mesent. ac.	Enteritis Colitis Typhlitis Epiploit. ac. u. a.	Ileitis terminalis
Uppsala .....	1943	88	—	—	—
	1944	90	2	—	—
Hälsingborg .....	1943	147	—	—	1
	1944	173	—	2	—
Lund .....	1943	135	—	1	2
	1944	161	—	1	3
Borås .....	1943	37	—	2	—
	1944	40	—	—	1
Lidköping .....	1943	52	15	2	—
	1944	49	18	1	—
Vänersborg .....	1943	35	40	—	—
	1944	37	51	—	1
Mariestad .....	1943	19	15	—	—
	1944	15	5	—	4
Östersund .....	1943	37	08	—	1
	1944	51	95	—	—
Jönköping .....	1943	58	34	34	—
	1944	68	32	3	—
Linköping .....	1943	25	29	67	1
	1944	31	39	40	—
Sundsvall .....	1943	68	50	—	—
	1944	8	57	—	—
Falköping .....	1943	21	34	8	1
	1944	30	—	2	—
Uddevalla .....	1943	85	—	—	—
	1944	37	36	—	—
Sahlgrenska I ...	1943	1	19	2	1
	1944	—	15	—	2

Baucherkrankungen dem Krankheitsbild zugrundegelegt werden sollen, das als akute Appendicitis fehlerhaft gedeutet oder vermutet wird. Es erscheint mir deshalb sehr wünschenswert, in unseren Krankenhäusern zu einer wenn möglich einheitlicheren Beurteilung dieser Fälle zu kommen, und diese in den Jahresberichten einheitlicher zusammenzustellen. Wäre es nicht geeignet, und ist nicht die Zeit gekommen für einen öffentlichen Meinungsaustausch zwischen den Repräsentanten der verschiedenen Anschauungen: Chirurgen mit einem hohen und Chirurgen mit einem niedrigen Prozentsatz falsch diagnostizierter akuter Appendicitisfälle, zwischen denen die alle diese Fälle unter der Diagnose Susp. app. ac. angeben, und denen, die in den Jahresberichten den grössten Teil der Fälle unter anderen Diagnosen anführen. Wäre es nicht geeignet, diese Frage als Vortrags- und Diskussions-

des Deltoideus entlang etwa 10 cm weit abwärts. Die in der Spalte zwischen dem vorderen Rande des Deltoideus und dem Pectoralis major verlaufende Vena cephalica wird aufgesucht. Der Deltoideus wird stumpf lateralwärts verlagert, der Pectoralis major und die Vena cephalica medialwärts. Durch Rotationsbewegungen des Oberarmes wird der Sulcus intertubercularis aufgesucht. Das den Sulcus intertubercularis deckende Ligamentum transversum humeri wird durchtrennt, wobei man die Sehne des langen Bizepskopfes zu Gesicht bekommt. Diese wird hoch in das Schultergelenk hinauf freipräpariert, wobei die Gelenkkapsel durchtrennt werden muss. Darauf wird der Arm etwas auswärts rotiert, so dass das Tuberculum minus und das medial von diesem gelegene Gebiet sich im Operationsfelde bieten. Die am Tuberculum minus und dem obersten Teil der Crista tuberculi minoris ansetzende Partie der Sehne des Musculus subscapularis wird an ihrem Ansatz durchschnitten. (Der Musculus subscapularis setzt ausserdem mit anderen Sehnenzügen direkt an der Gelenkkapsel an.) Mit dem Meissel wird gleich medial von (vor) dem Tuberculum minus eine Rinne angelegt. Die Sehne des langen Bizepskopfes wird vom Sulcus intertubercularis über das Tuberculum minus geschoben und in diese neu hergestellte Rinne medial von (vor) dem Tuberculum minus gelegt, wo sie mit Seiden- und Katgutnähten an die Knochenwände befestigt wird (bei den letzten Operationen wurden die beim Ausmeisseln der Rinne erhaltenen Knochenspäne über die Sehne gelegt, um der Rinne sozusagen ein Dach zu geben). Die früher durchtrennte Sehne des Musculus subscapularis wird darauf wieder an das Periost des Tuberculum minus genäht. Der vordere Rand des Deltoideus und der Pectoralis major werden einander wieder genähert und mit zwei—drei Katgutnähten aneinandergenäht. Die Haut wird darauf mit Seide oder Leinenfaden vernäht. Der Arm wird sofort in 90-gradiger Abduktion und etwa 30° vor der Frontalebene in eine metallene Abduktionsschiene gelegt. Der Kranke darf nach etwa zwei Tagen das Bett verlassen. Die Abduktionsschiene wird 14 Tage lang beibehalten (früher behielt man sie länger), worauf man den Patienten unmittelbar mit aktiven Bewegungen beginnen lässt, später evtl. durch passive Bewegungen, Massage und Wärmebehandlung vervollständigt.

Die Methode NICOLA's und ihre Modifikationen richten sich nicht gegen eine gewisse, pathologisch-anatomische Unterlage, sondern gehen nur darauf aus, den Humeruskopf an die Fossa glenoidalis anzubinden.

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Dass jedoch bei der habituellen Schultergelenkluxation eine spezifische pathologisch-anatomische Unterlage vorliegt, die sich von der pathologisch-anatomischen Unterlage bei der gewöhnlichen traumatischen Schultergelenkluxation unterscheidet, ist durch mehrere Beobachtungen wahrscheinlich gemacht worden. So trifft die erste Ausrenkung bei einer habituellen Schultergelenkluxation zumeist jüngere Personen, während die traumatische Schultergelenkluxation gewöhnlich bei Menschen in mittlerem oder höherem Alter vorkommt. Bei der habituellen Schultergelenkluxation kommt selten gleichzeitig eine Supraspinatusruptur oder ein Bruch des Tuberculum majus vor, was bei der traumatischen Schultergelenkluxation bedeutend häufiger passiert. Verschiedene Autoren haben diese und noch mehrere andere Unterschiede zwischen habitueller und traumatischer Schultergelenkluxation hervorgehoben. Man hat sich hierbei vorgestellt, dass der Grund, weshalb eine anscheinend gewöhnliche, traumatische Schultergelenkluxation in eine habituelle übergeht, durch konstitutionelle Veranlagung, primäre Deformität des Humeruskopfes, Ruptur der Supraspinatussehne mit daraus folgender Herabsetzung der Stabilität des Gelenks, kongenitale Prädisposition bedingt sei. BANKART betont im Jahre 1938 als seine Ansicht, dass die habituelle und die traumatische Schultergelenkluxation zwei ganz verschiedene Krankheiten darstellen, jede mit ihrer ganz besonderen pathologisch-anatomischen Unterlage. Nach BANKART ist die traumatische Schultergelenkluxation durch übermässige Abduktion verursacht. Die obere Partie des Humerus stemmt sich dann gegen das Akromion an, und der Gelenkkopf wird über den unteren Rand der Fossa glenoidalis aus dem Gelenk herausgehoben, indem er hier einen Kapselriss erzeugt. Dieser Riss in der Kapsel selbst heilt jedoch leicht, und deshalb geht eine traumatische Schultergelenkluxation niemals in eine habituelle Form über. Die vordere habituelle Schultergelenkluxation dagegen wird durch ein von hinten nach vorn gerichtetes Trauma gegen das Schultergelenk erzeugt, entweder ein direktes Trauma gegen das Schultergelenk oder ein in dieser Richtung wirkendes Trauma, das sich in der Längsrichtung des Humerus fortpflanzt, z. B. ein Fall hinüber auf den etwas nach aussen und hinten gerichteten Ellbogen. Durch solch ein Trauma presst sich der Humeruskopf vorn aus dem Gelenk heraus zwischen dem Knochenrand der Cavitas glenoidalis und dem Labrum glenoidale, das von seinem Knochenansatz an der Cavitas glenoidalis losgerissen wird. Die Heilungstendenz zwischen dem aus Knorpel bestehenden Labrum glenoidale und dem Knochenrand der Cavitas glenoidalis ist sehr schlecht und dies ist der Grund dafür, dass die Luxation habituell wird. BANKART hat bei 27 aufeinanderfolgenden Fällen bei der Operation diese Verletzung nachweisen können. Auch HYBBINETTE hat bei sämtlichen Fällen die er nach seiner eigenen intraartikulären Operationsmethode operierte, ungefähr die gleichen Verletzungen der Kapsel und des Labrum glenoidale gefunden. BOST und INMAN haben 10 Fälle und WATSON-JONES 34 Fälle nach der BANKART'schen Operationsmethode operiert und haben in sämtlichen Fällen die Ansicht BANKART's bestätigen können. MEYERS hat eine Operationsserie von 31 nach BANKART

disturbances due to pressure upon the sympathetic cords. There are, however, many indications that both mechanisms frequently concur. Besides, mixed cases are generally more common than cases presenting vascular symptoms alone.

### The Importance of the Costotransverse Process of the Seventh Cervical Vertebra.

Judging by the data available the transverse process of the seventh cervical vertebra is an anatomic detail the importance of which has so far received scant attention in connection with the scalenus anticus syndrome. As is well known, suspect cases of scalenus anticus syndrome are roentgenologically examined to ascertain whether a cervical rib is present, and frequently there is roentgen evidence of a comparatively large costotransverse process of the seventh cervical vertebra. In reality, all possibilities may occur ranging from processes being either short, long or bulky to frank cervical ribs of varying length. It is to some extent a matter of taste whether the terms long process or cervical rib are applied to this formation. In my cases I label with the term cervical ribs only those articulating with the transverse processes. A normal costotransverse process of the seventh cervical vertebra is shorter than a normal transverse process of the first thoracic vertebra. Literature, however, does not contain any data either on the variations in length of the process or its usual size. Fig. 1 illustrates the seventh cervical vertebra together with its transverse process. The *anterior costal process* and the *posterior transverse process* are plainly recognizable in this picture. Both processes are fused together forming a *costotransverse process* whose anterior part is thus formed by the rudimentary rib. In examining some hundred skeletons at the Institute of Anatomy of Upsala, I found that the transverse process varies very little in size whereas the costal process may present a variety of appearances. They may be classed into two main types, viz. type 1, presenting a costal process projecting to a lesser degree (fig. 1), and type 2, presenting a costal process projecting more or less in the shape of a club (fig. 2) forming a transitional stage between the latter and a frank cervical rib. The costal process thus is the variable factor and always *forms the tip of the process*. If the transverse process is measured in the roentgenogram the length of the anterior costal part of the



oder einer Modifikation dieser Methode operierten Fällen veröffentlicht. In sämtlichen Fällen lag eine Abreissung des Labrum glenoidale oder der Kapsel von der Cavitas glenoidalis vor. WATSON-JONES erwähnt jedoch, dass es zum Entdecken der Verletzung notwendig ist, den Processus coracoidens zu durchtrennen, die Sehne des Musculus subscapularis zu durchtrennen und von der Gelenkkapsel freizupräparieren, die Gelenkkapsel zu eröffnen und das Caput humeri durch Zug am Arme durch einen Assistenten dazu zu bringen, sich aus Fossa glenoidalis herauszuheben. Andererseits haben ODGERS und HARK nur bei 3 von 12 Operationen diese Verletzung am Labrum glenoidale nachweisen können. MAGNUSSON hält diese Verletzung für bedeutungslos und hat sie nur bei einigen wenigen Operationen finden können. Ob diese Verletzung des Labrum glenoidale nur bei gewissen Fällen von vorderer habitueller Schultergelenkluxation vorkommt, oder ob sie wirklich, wie WATSON-JONES es ausdrückt, den essentiellen anatomischen Defekt darstellt, ist bei Verwendung der NICOLA'schen Operationsmethode und deren Modifikationen jedoch bedeutungslos, da diese sich, wie oben erwähnt, nicht gegen einen gewissen anatomischen Defekt richten, sondern nur darauf ausgehen, den Humeruskopf an die Cavitas glenoidalis anzubinden.

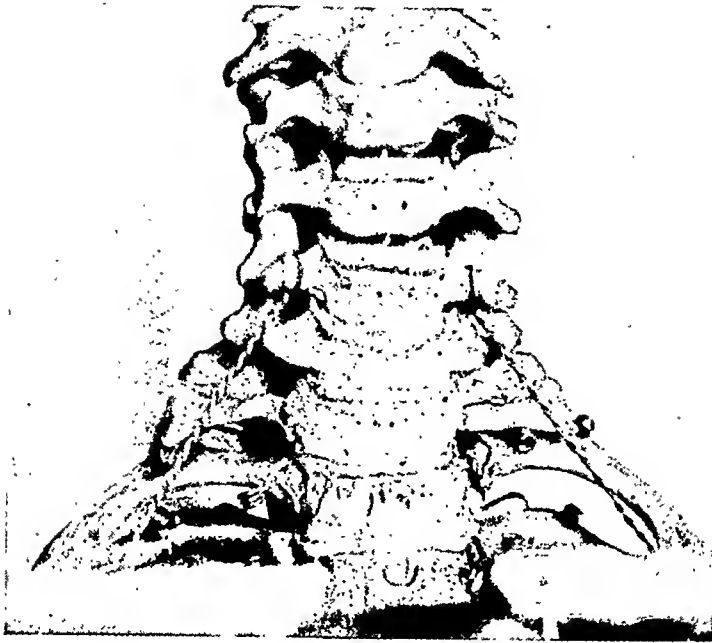
Mit der im obigen beschriebenen Modifikation der NICOLA'schen Methode sind in dem Krüppelanstalt in Hälsingborg seit dem Jahre 1943 9 Fälle von vorderer habitueller Schultergelenkluxation operiert worden, über die im nachstehenden näher berichtet werden soll.

1. Aufnahmenr. 30976. S. T., männl. 1913 geboren. Ladengehilfe. Im Jahre 1940 fiel Patient beim Gymnastikmachen und zwar auf den rechten Ellbogen, wobei die rechte Schulter ausgerenkt wurde. Seither etwa 10 Luxationen gehabt.

Befund am 5. 2. 43: Normale Beweglichkeit. Keine Muskelatrophie. Röntgen: Deformansstachel am unteren Rande der Cavitas glenoidalis. Im übrigen nichts Anormales. (Sowohl bei diesem Falle als auch bei den folgenden ist nur eine routinemässige Röntgenaufnahme gemacht worden. Aufnahmen in den verschiedenen Rotationsphasen sind also nicht gemacht worden. Auch wurde keine Arthrographie vorgenommen.)

Op. am 6. 2. 43 (STENPORT). Am 2. 3. entlassen. Damals subjektiv und objektiv beschwerdefrei, mit Ausnahme einer gewissen Steifigkeit im rechten Schultergelenk. Bei Nachuntersuchung am 14. 9. 43: Volle Beweglichkeit, seit der Operation keine Luxation.

Nachuntersuchung durch Fragebogen im März 1946: (Da die Patienten des Krüppelanstalts wegen des verhältnismässig grossen Aufnahmegebiets oft recht weit von der Anstalt ansässig sind, ist die Nachuntersuchung dieser Patienten zumeist nur mittels Fragebogens vorgenommen worden.) Keine Rückfälle. Beweglichkeit normal. Keine Schmerzen. Nahm 6 Wochen nach der Operation seine Arbeit als Ladengehilfe auf. Kann jetzt seine Arbeit ebenso gut leisten wie vor der ersten



ig. 1. The cervical vertebrae and the first thoracic vertebra. (From the Institute of Anatomy of Upsala.)

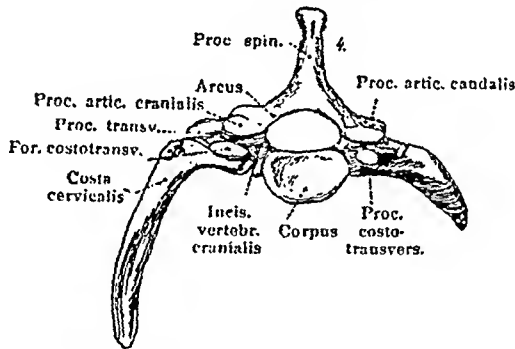


Fig. 2. Examples of variations of the seventh cervical vertebra. (From Spalteholz' Handatlas 1939.)

process is obtained. To determine this length I measure the distance between the lateral edge of the articular process of the vertebra, which is clearly recognizable in the roentgenogram, and the tip of the process at right angles to the cervical axis of the body of the vertebra. For comparison the seventh cervical vertebra and the first thoracic vertebra are measured in like manner (fig. 3). By expressing these lengths in terms of millimeter and multiplying them by 100 an index-number is obtained indicating the relative length of the transverse process of the

Luxation. Hat im Jahre 1945 unbehindert an Schauturnen teilgenommen.

2. Aufnahmenr. 34263. E. A., männl. 1921 geboren. Ladenvorsteher. Die rechte Schulter 6 mal luxiert, das erstemal vor einem Jahre.

Befund am 8. 2. 44: Rechte Schulter objektiv o. B. Röntgen: Nichts Anormales.

Op. am 9. 2. 44 (STENPORT). Am 14. 2. mit Abduktionsschiene entlassen, die er noch einige Zeit tragen sollte. Nachuntersuchung am 6. 3. 44: Symptombfrei.

Nachuntersuchung mittels Fragebogens im März 1946: Keine Rückfälle. Beweglichkeit normal. Keine Schmerzen. Nahm seine Arbeit als Ladenvorsteher 37 Tage nach der Operation auf. Kann seine Arbeit jetzt ebenso gut leisten wie vor der ersten Luxation.

3. Aufnahmenr. 34589. H. F., männl. 1921 geboren. Norwegischer Flüchtling. In den letzten vier Jahren 7—8 Mal Luxation des rechten Armes.

Befund am 7. 3. 44: Bewegungen frei, auch im übrigen nichts Anormales. Röntgen: Nichts Anormales.

Op. am 8. 3. 44 (STENPORT). Am 31. 3. wurde die Abduktionsschiene entfernt. Konnte den Arm sofort recht gut bewegen, entlassen. War bei der Nachuntersuchung leider nicht auffindbar.

4. Aufnahmenr. 34978. I. S., weibl. 1917 geboren. Dienstmädchen. Die rechte Schulter vor neun Jahren zum erstenmale ausgerenkt. Seitdem mindestens 25 Luxationen.

Befund am 20. 4. 44: Grobe Krepitationen in beiden Schultergelenken, besonders rechts. Volle Beweglichkeit. Keine Muskelatrophie. Röntgen: Nichts Anormales.

Op. am 22. 4. 44 (STENPORT). Am 6. 5. mit Abduktionsschiene entlassen. Am 1. 6. Abduktionsschiene abgelegt. Am 13. 6. Beweglichkeit fast normal. Nachuntersuchung durch Fragebogen im März 1946: Die Eltern der Patientin teilen mit, dass sie am 2. 2. 46 an Komplikationen nach einer Entbindung gestorben ist. Die Eltern geben jedoch an, dass die Patientin nicht an Schmerzen gelitten habe, dass sie keine Rückfälle gehabt habe, dass die Beweglichkeit normal geworden sei, dass sie drei Monate nach der Operation ihre Arbeit als Dienstmädchen wieder aufgenommen habe und ihre Arbeit ebenso gut habe besorgen können wie vor der ersten Luxation.

5. Aufnahmenr. 36365. K. E., weibl. 1899 geboren. Keine Arbeit ausserhalb des Hauses. Luxierte das rechte Schultergelenk vor zehn Jahren. Seither sehr viele Luxationen, letzten Sommer mindestens 10 mal.

Befund am 24. 10. 44: Nichts Anormales. Röntgen: Nichts Anormales.

Op. am 25. 10. 44 (STENPORT). Am 4. 11 entlassen, wobei die Abduktionsschiene entfernt wurde.

Nachuntersuchung durch Fragebogen im März 1946: Keine Rückfälle. Beweglichkeit normal. Manchmal unbedeutende Schmerzen im rechten Schultergelenk. Kann die Haushaltsarbeit ebenso gut besorgen wie vor der ersten Luxation.

2. *Intermittent resection* as the first-stage operation, and resecting the seat of the tumour at a subsequent laparotomy. Here it is a question of two complete laparotomies with a comparatively short interval, and it can thus be argued whether these are less detrimental to the patient than a single major procedure.

However, the use of one of these multiple-stage operations should sometimes be contemplated when dealing with instances of acute, marked ileus, a condition that, whilst rather infrequently associated with caecal cancer, yet has a decidedly unfavourable influence on the prognosis in cases where primary resection is adopted.

With primary resection in *other parts of the colon* (i. e. with the exception of the caecum and ascending colon), there is, as is shown by the previous statement, very serious danger of *leakage resulting in peritonitis*, which admittedly can be restricted, but by no means wholly eliminated, by making a temporary colonic fistula proximal to the site of resection. The same can be said of chemotherapy and of measures aiming at maintaining after the resection a fluid consistency of the bowel contents. The danger of peritonitis associated with primary colonic resection is also stressed in the literature. Thus, VON HABERER regards leakage with peritonitis as the principal risk of primary resection. Further, in the majority of statistical surveys peritonitis is the most frequent cause of death after colonic resection. For example, ZINNINGER (1943) states that one-half of the fatalities are due to peritonitis. ALLEN (1943) found 41 fatalities caused by peritonitis among 86 deaths; RANKIN 14 out of 26, and MAYO-SIMPSON 21 out of 33. In a more comprehensive series reviewed by OCHSNER-DE BAKEY (1939), out of 412 fatalities 41.7 per cent resulted from peritonitis.

In consequence of this appreciable danger associated with primary resection of the colon, the *Bloch-Mikulicz multiple-stage procedure* was introduced, in which the resection and the restoration of the passage are carried out extraperitoneally. It is established beyond doubt that the risks of colonic resection are reduced by this procedure. Thus, MIKULICZ was able, under the conditions prevailing at the time of his report on the method, to lower the mortality from 43 to 13 per cent in a selected series (comprising no cases with ileus; he advised against operation at the stage of intestinal obstruction). — The fact that the procedure is of multiple-stage character is to some extent a disadvantage, though not a material one. The crushing of the spur

6. Aufnahmenr. 36770. I. M., weibl. 1917 geboren. Dienstmädchen. Das rechte Schultergelenk mindestens 5 mal ausgerenkt.

Befund am 4. 11. 44: In der rechten Schultergelenkregion objektiv nichts zu finden. Röntgen: Nichts Anormales.

Op. am 4. 11. 44 (STENPORT). Am 14. 11. mit Abduktionsschiene entlassen.

Nachuntersuchung in dem Krüppelanstalt in Hälsingborg im März 1946: Keine Rückfälle. Normale Beweglichkeit. Hin und wieder einmal nach Anstrengungen unbedeutende Schmerzen im rechten Schultergelenk. Nahm 35 Tage nach der Operation ihre Arbeit als Dienstmädchen wieder auf. Besorgt nun ihre Arbeit als Dienstmädchen ebenso gut wie vor der ersten Luxation.

7. Aufnahmenr. 37800. G. J., männl. 1907 geboren. Holzhofarbeiter. Rechte Schulter im Februar 1944 zum erstenmale ausgerenkt. Seitdem weitere 3 mal, jedesmal bei immer geringerer Gewaltwirkung.

Befund am 27. 2. 45: Beweglichkeit des rechten Schultergelenks etwas beschränkt, besonders bei Abduktion. Keine Muskelatrophie.

Op. am 28. 2. 45 (STENPORT). Am 27. 3. entlassen, hatte damals fast normale Beweglichkeit.

Nachuntersuchung durch Fragebogen im März 1946: Keine Rückfälle. Beweglichkeit »nicht ganz so gut, wie in der gesunden Schulter«. Manchmal unbedeutende Schmerzen. Nahm 47 Tage nach der Operation seine Arbeit als Holzhofarbeiter wieder auf. Kann jetzt jede beliebige Arbeit verrichten, »wenn sie nur nicht zu schwer ist«.

8. Aufnahmenr. 40371. S. W., männl. 1917 geboren. Sergeant. Durch Sturz von einer Höhe zog Patient sich am 27. 10. 44 eine linksseitige Schultergelenkluxation zu. Seither wiederholte Luxationen auf die geringste Veranlassung hin, mindestens einige 20.

Befund am 18. 1. 46: Normale Beweglichkeit. Keine Muskelatrophie.

Op. am 19. 1. 46 (STENPORT). Am 4. 2. entlassen, wobei die Abduktionsschiene entfernt wurde. Am 18. 2. symptomfrei.

Nachuntersuchung durch Fragebogen im März 1946: Keine Rückfälle. Beweglichkeit »noch nicht völlig normal«. Keine Schmerzen. Nahm 32 Tage nach der Operation seine Arbeit als Sergeant wieder auf. Meint seine Arbeit noch nicht ebenso gut verrichten zu können wie vor der ersten Luxation.

9. Aufnahmenr. 41029. A. S., männl. 1921 geboren. Bautischler. Erste Luxation am 17. 6. 45 durch Sturz von einer Höhe. Seither einige 15 Luxationen.

Befund am 16. 4. 46: Normale Beweglichkeit. Keine Muskelatrophie. Röntgen: Nichts Anormales.

Op. am 17. 4. 46 (JERRE). Am 26. 4. mit Abduktionsschiene entlassen. Am 2. 5. wurde die Abduktionsschiene entfernt. Hatte schon damals recht gute Beweglichkeit. Am 9. 5. subjektiv völlig beschwerdefrei. Fast normale Beweglichkeit, es fehlen nur 15° an voller Abduktion und 15° an voller Elevation nach vorn. Am 16. 5. subjektiv völlig beschwerdefrei. Normale Beweglichkeit. Hat als Bautischler schwere Arbeit. Soll sich deshalb weitere 2 Wochen erholen.

Table No. 3.

Case No.	General symptoms	Diarrh.	Abdom. pain	Abdom. swelling	Haematuria	Urinary urgency	Tumour	Time lost	Wrong diagnosis No. of times					
1				1	2			0 + 8 mos.	1					
2		1					2	2 mos.						
3	1				2			3 mos.						
4	1						2	0? + 10 mos.	4					
5			2		1			0 + 21 days	3					
6	1	2						c. 7 + 28 days	2					
7				1			2	4 mos.						
8		2		1				4 mos. + 14 days	2					
9								2 mos.	1					
10	1		2					6 mos. + 7 days	1					
11	1						2	7 mos.						
12		1					2	2 mos.						
13					1	2		0						
14	1					2								
15	1						2	4 mos.						
16		2				2		3 mos.						
17				1	2		1	1 + 4 mos.	1					
18	1				2			? + 9 mos.	1					
								1 mo.						
	8	3	2		2	4	3	2	3	1	1	6	Average 4 mos.	16

quite recently presented by B. S. ABESHOUSE & T. WEINBERG that the haemorrhage and necroses occurring inside the tumour would play a part in the rise of the fever. (Why not?) The tumour was observed at home in 9 patients and in 8 was discovered on admission into hospital. In No. 5, who had at home suffered from haematuria, pain and fever, the tumour was diagnosed only three weeks after admission in connection with a severe attack of pain (caused by intratumoural haemorrhage?). The "portion of a vein" noted by the patient's mother was most probably a blood clot having formed in the urether. It does not appear from the macroscopic description of the specimen whether the tumour extended as far as the renal pelvis. If this was the case we may have here a detached portion of the tumour as found in each of U. QUENSEL's and T. G. NYSTRÖM's series in one case. The classical triad: Haematuria, pain and a palpable tumour, so common in connection with other types of renal tumours, occurs in two cases only (Nos. 14 and 17).

In Table 3 the first symptoms observed at home are marked 1 while those leading to diagnosis through medical examination or admission to hospital are marked 2. For the sake of convenience

Es sind im ganzen neun Fälle nach der im obigen beschriebenen Methode operiert worden. Von ihnen war ein Fall nicht auffindbar. Ein Fall ist an einer interkurrenten Erkrankung gestorben, war aber vor dem Todesfalle völlig wiederhergestellt und beschwerdefrei. Die Beobachtungszeit ist für zwei Fälle sehr kurz, im übrigen aber liegt sie zwischen reichlich einem Jahr und reichlich drei Jahren. Rückfälle sind nicht vorgekommen. Der Krankenhausaufenthalt und die Dauer der Arbeitsunfähigkeit nach der Operation waren kurz, im Vergleich zu dem, was bei den meisten anderen Operationsmethoden bei habitueller Schultergelenkluxation der Fall zu sein pflegt. Fortdauernde Beschwerden fehlen oder sind doch überaus gering.

Durch die verwendeten Modifikationen der NICOLA'schen Operationsmethode hat man gewisse Vorzüge gewonnen, die sich folgendermassen zusammenfassen lassen:

1. Die Operationstechnik ist einfacher.
2. Der Eingriff ist kleiner und erfordert nicht so breite Eröffnung des Gelenks.
3. Es wird keine Verletzung des Gelenkknorpels gesetzt.
4. Die Sehne des langen Bizepskopfes wird nicht durchtrennt.

Schliesslich sei hervorgehoben, dass die zum Anbinden des Caput humeri an die Fossa glenoidalis verwendete Sehne bei dieser Modifikation weit medial am Humeruskopf befestigt wird. Aus rein mechanischen Gründen ist dies sehr wichtig, was u. a. von KAPEL und NICOLA betont wurde, und was bei der Originalmethode NICOLA's auch gut berücksichtigt worden ist, dagegen weniger gut bei gewissen Modifikationen derselben, z. B. WAHL's und HOBART's.

Die primären Ergebnisse, die bei Verwendung der oben beschriebenen Modifikation der NICOLA'schen Methode erhalten wurden, sind als sehr gut zu bezeichnen. Ob die endgültigen Ergebnisse ebenso gut ausfallen werden, darüber kann man sich z. Z. noch nicht äussern, da Rückfälle sehr spät auftreten können.

Vergleicht man die Ergebnisse bei der Operationsmethode NICOLA's und ihren Modifikationen mit denjenigen bei EDEN-HYBBINETTE's und BANKART's Methoden, so wird dieser Vergleich inbezug auf die Endergebnisse nicht zum Vorteil der NICOLA-Methode ausfallen. Freilich hat NICOLA selber im Jahre 1934 eine Nachuntersuchung seiner seit 1928 operierten Fälle, deren Zahl 32 beträgt, veröffentlicht. Nur in einem Falle ist Rezidiv aufgetreten, und hier auch nur einmal. NICOLA erwähnt in der gleichen

Publikation, dass er von 3 Fällen von Rezidiv erfahren hat bei Patienten, die nach seiner Methode von anderen Chirurgen operiert worden waren. Bei 2 von diesen 3 Fällen wurde erneute Operation vorgenommen. Bei dem einen Falle stellte sich heraus, dass der Bohrkanal durch den Humeruskopf allzu breit gemacht worden war, so dass die Sehne hatte auf- und abgleiten können und schliesslich völlig durchgerieben worden war. Bei dem anderen Falle war der Bohrkanal an falscher Stelle angelegt worden, so dass nicht die richtige Fixation der Humeruskopfes an die Cavitas glenoidalis erzielt wurde. Diese Rückfälle beruhten also nach NICOLA nicht auf einer Schwäche seiner Operationsmethode sondern auf technischen Fehlern. Auch ROBERTS, BURNET, FREJKA und CAMITZ haben mit verschiedenen Modifikationen der Methode NICOLA's gute Erfolge aufweisen können, was im nachstehenden näher besprochen werden soll. Ferner hat AHLBERG 4 mit der KJELL BERGMAN'schen Modifikation operierte Fälle ohne Rezidive veröffentlicht. Andererseits teilt WATSON-JONES mit, er habe 18 Fälle nach der Methode NICOLA's operiert. Bei nicht weniger als 5 derselben traten Rückfälle auf. HUBLIN hat die HEYMANOWITSCH'sche Methode bei 9 Fällen verwendet. Nach drei Jahren waren bereits zwei Rezidive aufgetreten, und bei einer späteren Nachuntersuchung stellte sich heraus, dass alle die 7 Patienten, die wiedergefunden werden konnten, Rückfälle bekommen hatten. Schliesslich gibt THOMASEN an, dass unter 225 im Schrifttum veröffentlichten Fällen, die mit verschiedenen Aufhängungsmethoden operiert worden waren, 32 Rückfälle aufgetreten seien, was 14 % ausmacht.

Operation nach EDEN-HYBBINETTE hat sehr gute Erfolge gegeben. So hat DAHLGREN eine Operationsreihe von 39 nach EDEN-HYBBINETTE operierten Fällen veröffentlicht. Ein Kranker starb an Lungenembolie, 2 erlangten nicht vollgute Beweglichkeit, 2 bekamen je einen Rückfall nach einem starken Trauma dann aber keine weiteren Rezidive, Spontanrezidive kamen nicht vor. THOMASEN, der selber 8 Fälle mitgeteilt hat, die nach dieser Methode operiert und rezidivfrei waren, hat eine Zusammenstellung von nach EDEN-HYBBINETTE behandelten und von verschiedenen Operateuren veröffentlichten Operationsserien gemacht. Hierbei ist es ihm gelungen, 169 nach dieser Methode operierte Fälle zu sammeln, und zwar mit nur einem Spontanrezidiv.

Auch BANKART's Operationsmethode hat sehr gute Erfolge gegeben. So hat BANKART selbst eine Reihe von 27 aufeinanderfol-



genden Fällen ohne Rückfall mitgeteilt, WATSON-JONES 34 Fälle ohne Rückfall, ODGERS und HARK 12 Fälle ohne Rezidiv, BOST und INMAN 10 Fälle mit einem Rezidiv bei einem Epileptiker und MEYERS 31 nach BANKART's Methode oder einer Modifikation derselben operierte Fälle ohne Rückfall.

Die mit den Operationsmethoden von EDEN-HYBBINETTE und BANKART erzielten Ergebnisse sind also inbezug auf die Rezidivfrequenz sehr gut und übertreffen die mit der NICOLA'schen Methode gewonnenen Durchschnittsresultate bedeutend. Ob die endgültigen Resultate bei der in dem Krüppelanstalt in Hälsingborg verwendeten Modifikation der NICOLA'schen Methode durch den operationstechnischen Faktor, dass die Sehne nicht durchtrennt wird, besser ausfallen werden, darüber kann man bisher noch nichts Sicheres aussagen. Vielleicht kann man immerhin darauf hoffen. Der Umstand, dass die Sehne durchtrennt wird, muss nämlich eine Schwäche der NICOLA'schen Methode ausmachen, was u. a. WATSON-JONES und FREJKA betont haben. So sagt FREJKA: »denn wenn es vorkomme, dass die periostale Naht der Sehne nachlässt, dann sei nicht nur die Sehne geschwächt, sondern man erreiche auch nicht den Erfolg der Befestigung des Schultergelenks«. In WATSON-JONES's obenerwähnter Operationsserie von 18 nach NICOLA's Methode behandelten Fällen traten nicht weniger als 5 Rückfälle auf. Von ihnen wurden 4 erneut operiert, und zwar mit einer anderen Methodik. Es stellte sich hierbei heraus, dass die Sehne in sämtlichen 4 Fällen abgerissen war. Ferner teilt HUBLIN mit, dass er bei Reoperation wegen eines Rezidivs bei einem Falle, der früher nach HEYMANOWITSCH, also mit Durchtrennung der Sehne des langen Bizepskopfes, operiert worden war, die Sehne so stark atrophisch und gedehnt fand, dass sie nicht mehr die geringste Fixationswirkung zwischen Caput humeri und Fossa glenoidalis ausüben konnte. Bei den Modifikationen von FREJKA, ROBERTS und CAMITZ wird die Sehne nicht durchtrennt. ROBERTS hat 2 nach seiner Modifikation operierte, freilich recht frische Fälle ohne Rezidiv mitgeteilt, BURNET 9 nach ROBERTS operierte ohne Rezidiv, FREJKA 5 Fälle mit einem Rückfall, den er selber als dadurch bedingt ansieht, dass die Vertiefung und Verlängerung des Sulcus intertubercularis in diesem Falle nicht genügenden Umfang hatte. Schliesslich hat CAMITZ eine Zusammenstellung von 13 Fällen veröffentlicht. Er gibt an, dass er im Jahre 1940 seine neue Methodik ohne Durchtrennung der Sehne des langen Bizepskopfes zu verwenden begann

Seit 1940 hat er 10 Fälle operiert. Von diesen konnte ein Fall nicht wiedergefunden werden und einer rezidierte 2 mal.

Die in dem Krüppelanstalt in Hälsingborg verwendete Modifikation der NICOLA'schen Operationsmethode hat gewisse Vorzüge vor NICOLA's Originalmethode, worüber im obigen näher berichtet wurde. Sie wird vor EDEN-HYBBINETTE's und BANKART's Methoden empfohlen, da der Eingriff so viel kleiner ist, die Technik so viel leichter, der Krankenhausaufenthalt und die Dauer der Arbeitsunfähigkeit so viel kürzer. Selbst wenn auf einem späten Stadium des Nachverlaufs nach der Operation vereinzelt Rezidive auftreten sollten, so hat man immerhin den Vorteil gewonnen, dass die Mehrzahl der Patienten durch einen sehr geringen und technisch überaus leichten Eingriff definitiv geheilt wurden und also nicht dem technisch viel schwereren und auch bedeutend grösseren Eingriff nach EDEN-HYBBINETTE oder BANKART mit den daraus folgenden Gefahren unterworfen zu werden branchten. Auch sind durch den vorgenommenen kleinen Eingriff im Schultergelenk und seiner Umgebung nicht Verhältnisse geschaffen worden, die eine evtl. notwendige Reoperation nach z. B. EDEN-HYBBINETTE oder BANKART irgendwie nennenswert erschweren würden, falls ein Rückfall auftreten sollte.

### Zusammenfassung.

Verf. beschreibt eine Modifikation der NICOLA'schen Operationsmethode bei vorderer habitueller Schultergelenkluxation, die STENPORT im Jahre 1943 in dem Krüppelanstalt in Hälsingborg zu verwenden begann. Im ganzen sind 9 Fälle mit dieser Methodik operiert worden. Bei der Nachuntersuchung konnte ein Fall nicht wiedergefunden werden. Die Beobachtungszeit war in 2 Fällen sehr kurz, bei den übrigen lag sie zwischen reichlich einem Jahr und reichlich drei Jahren. Rückfälle sind nicht aufgetreten. Die Methode wird empfohlen, da der Eingriff so klein ist, die Technik so einfach, der Krankenhausaufenthalt und die Dauer der Arbeitsunfähigkeit so kurz, und da evtl. zurückbleibende Beschwerden fehlen oder überaus gering sind.

### Summary.

The author describes a modification of Nicola's method of operating habitual anterior luxation of the shoulder joint which

STENPORT started using at the Institute for Cripples in Hälsingborg in 1943. Nine cases in all have been operated on in accordance with this method. One of the cases could not be traced during the re-examination. In two cases the observation time was very short whilst for the others it lasted from a little over one year to a little over three years. There have been no relapses. The method is recommended as the operation is so small, the technique so simple, the time spent in hospital as well as that during which the patient is incapacitated from working of so short a duration and that there are no, or very insignificant, troubles remaining.

### Résumé.

L'auteur décrit une modification de la méthode opératoire de Nicolas dans la luxation récidivante antérieure de l'épaule, telle que STENPORT a commencé à l'employer en 1943 à l'Institut Orthopédique de Hälsingborg. En tout, 9 cas ont été opérés selon ce procédé. Lors des examens ultérieurs de contrôle l'un n'a pu être retrouvé. Pour deux, la durée d'observation était très brève, pour les autres elle allait d'un à trois ans largement comptés. Aucune récurrence n'est survenue. L'auteur recommande la méthode attendu que l'intervention est si modeste et sa technique si simple; que l'hospitalisation et l'incapacité de travail sont si courtes; et enfin que les troubles résiduels possibles sont ou nuls ou tout à fait insignifiants.

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## Case of Spontaneous Rupture of the Subclavian Artery.

By

ERLING SCHROEDER.

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Arterial ruptures are rare. Most often they are due to traumatic injury, while the so-called spontaneous ruptures, as a rule, are due to arteriosclerosis or inflammatory changes in the wall of the arteries. It happens but exceedingly seldom that an artery ruptures without a preceding traumatic injury or without any macroscopically or microscopically demonstrable cause.

Here a report will be given of such an instance of spontaneous rupture of the subclavian artery.

### Case history.

The patient was a boy, 16 years old, milkman's assistant, who was admitted on the 29th of November 1944 to the Surgical Dept. of the Copenhagen County Hospital (Record No. 3165/44) under the diagnosis: Contusion of the chest, with hematoma; internal hemorrhage; severe anemia.

*Family History:* The patient is No. 3 of 4 children. An older sister was subject to epistaxis till the age of 14. Otherwise no known instance of tendency to hemorrhage in the family.

*Past History:* The patient has always been liable to epistaxis, often without any external cause; otherwise no tendency to bleeding. His health has always been good.

*Present Illness:* The patient has previously worked as delivery boy for a grocer, bell-boy, and lately as milkman's assistant. 6 days before admission, while lifting a box of milk bottles, weighing 25—30 pounds,

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<sup>1</sup> Read before the Danish Surgical Society on December 8, 1945.

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up on the milk wagon, he suddenly had an attack of intense pain in the right shoulder. He applied to the emergency ward of the Kommune Hospital, where he was told that he had ruptured a muscle fiber. He was advised to treat it with cold compresses. In the same evening already his mother noticed some ecchymoses on the upper part of the arm. After his visit to the emergency ward, however, the patient was able to keep working the rest of that day and also the following two days without noticing any particular discomfort. Then he had his regular vacation for 8 days. He still felt no discomfort in the arm, and he was able to repair a puncture on his bicycle and ride some distance — from the country to the town. Still he consulted the physician, 4 days after the accident, on account of the ecchymoses; and now he was advised to use hot compresses in the evening. In the following evening, after application of the hot compress he again had an attack of pain in the shoulder, but this pain subsided on removal of the compress. The following night he slept well, and he noticed nothing in particular before the next morning, when he fainted after getting out of bed. Now the mother noticed that he was strikingly pale, and that a large swelling had appeared on the right side of the chest. The summoned physician sent the boy to the hospital at once.

*Physical Examination:* On admission the patient appeared very thin and exceedingly miserable, ghastly pale and slightly cyanotic, with dyspnea. Extremities cool. Pulse imperceptible. The patient was moaning, but able to answer questions. The right axilla and the lateral part of the right side of the chest presented a large, fluctuating hematoma, about  $12 \times 12$  cm., besides some ecchymoses of an older date. Also hematoma and ecchymoses of the right arm, down to the elbow. No sign of any fracture of the ribs. Otherwise no abnormality.

The cause of the severe hemorrhage was obscure — either rupture of a muscle, or tearing of a large blood vessel, or possibly hemophilia.

*Treatment and Course:* Immediately after admission, blood grouping was performed on the patient and his mother. Both belonged to group O.

*Blood transfusion* was then performed — 600 cc. from the mother — into the vena saphena magna of the right leg, after it had proved impracticable to enter a vein in the bend of the left elbow. The veins were markedly thin-walled and small, and the transfusion was very difficult because the veins ruptured readily. In addition the patient was given saline, 1.5 liters intravenously, and Pentazol, 5 cc. intramuscularly.

The patient responded immediately to this treatment, the pulse becoming palpable — about 130 per min. — regular and soft; and the complexion became more healthy.

But soon the condition of the patient got worse again, so that blood transfusion had to be repeated. Before this could be done, however, the patient died, 6 hours after admission.

Two days later, autopsy was performed in the University Institute of Forensic Medicine (Record No. E. 68/44).

*Autopsy Record:* Length of the body 160 cm.; weight 42 kg. Build delicate. Nutrition subnormal. Rigor and livor mortis present. The

upper right side of the chest shows an extensive flat swelling, over which the skin is bluish-red, and this discoloration extends down the posterior aspect of the right arm to the middle of the fore-arm. The swelling is quite soft, and on palpation it conveys a distinct impression of a large accumulation of fluid in the subcutis. No evidence of any external injury here.

*Internal Examination:* The right pleural cavity contained 75 cc. fluid blood. Before removal of the organs — in particular, before the cervical vessels are divided — an incision is made in the skin from the top of the anterior axilla down through the right side of the chest, laying open the right axilla and the soft part on the right side of the chest. A large and extensive extravasation of blood is found in the right axilla, in the subcutis and between the muscles on the right side of the chest, corresponding to the swelling described here. The extravasation further extends along the large vessels and nerves.

The large vessels and nerves in the axilla are then dissected out. This reveals an opening, about  $1 \times \frac{1}{2}$  cm., in the third part of the subclavian artery, at the transition to the axillary artery. There can be no doubt that the large hemorrhage has come from this arterial rupture.

The skull, brain, neck and chest organs, heart, aorta, pulmonary vessels and carotids, stomach, intestines, liver, gall-bladder, adrenals, pancreas, spleen, kidneys and urinary passages present no abnormality. The amount of blood is scanty, partly fluid, partly clotted. No evidence of any fracture.

The connective tissue and the walls of the blood vessels, veins as well as arteries, are very hypoplastic. The hypoplasia appears on the whole to be localized to tissues of mesodermal origin.

*Recapitulation and Conclusion:* The autopsy has revealed a very large recent hemorrhage into the musculature and other soft parts round the right axilla. The starting point of this hemorrhage is found to be a small rupture in the right subclavian artery. No morbid changes are demonstrated in the wall of the vessel at the site of the rupture. All the organs are found to be very poor in blood.

No sign of any disease is demonstrated, nor any sign of violent injury apart from the arterial rupture and the large hemorrhage.

The cause of death is the hemorrhage from the demonstrated arterial rupture. From the data in the history of the patient, it is only reasonable to attribute the arterial rupture to the work of deceased, lifting the heavy box on <sup>23</sup>/<sub>11</sub> 44. During this exertion, presumably a break has taken place in some layers of the arterial wall (a so-called incomplete rupture), and this rupture must be assumed to have become complete on the day of exitus.

*Histological Examinations:* In sections from the right subclavian artery and vein the walls of the vessels are rather thin, but otherwise the various layers appeared to be of normal structure, and sections stained for elastin show large amount of elastic tissue in the walls of the vessels. The relative amount of elastic tissue seems normal. No evidence of inflammatory processes in the walls of the vessels.

In sections from the aorta the wall is strikingly thin, but here too the structure appears normal otherwise, and the amount of elastic tissue in the wall seems to be normal.

Sections from the skin show no definite abnormality, but the walls of the vessels appear rather thin. — In all the parts examined the arterial walls look relatively thinner than the venous.

*Histological diagnosis:* Hypoplasia of the walls of the blood vessels, especially the arteries. (Dr. HARALD GORMSEN.)

## Discussion.

This case is quite unusual. Here is a boy, 16 years old, with a past history of good health, performing a relatively easy work as lifting a box of 25—30 pounds up on a wagon — something he has done innumerable times before -- and now it gives him a rupture of the subclavian artery.

Presumably this exertion has been followed by a very small but complete rupture. Otherwise it would be difficult to explain the extravasation of blood that appeared soon after — unless there was at the same time a muscular rupture, though it would seem rather far fetched to assume this possibility. A somewhat similar phenomenon has been observed in stab or cut wounds in blood vessels that may close again. On the other hand, in this case the symptoms were remarkably few. As a matter of fact, the patient was practically symptom-free until 6 days later when he had the large fatal hemorrhage. This is more in keeping with the view of the pathologist that the primary injury has been an incomplete rupture which without any additional external factor — apart from the hot compress, if this has been of any significance — has become complete 6 days later.

But how may it happen that an apparently healthy boy of 16 years has a rupture of such a large vessel as the subclavian artery? There can hardly be any doubt that this has been due to combination of a mechanical factor and a disposition to abnormal vascular fragility.

On going through the literature with a view to this point I have found only one case that really resembles our case a great deal, on which account it will be appropriate here briefly to cite the case reported. It was published in 1929 by HANF-DRESSLER.

This patient was a gardener's assistant with a past history of good health. He was very liable to epistaxis. He was an ardent sportsman, boxing, swimming and training in light-weight athletics, and in this way



he acquired an "athletic heart", for which he was treated with dietary measures and with heart vibration massage. In spite of prohibition, he continued training, and one day, after swimming 300 meters, he felt a pricking pain in the right shoulder. Before going to bed, however, he performed some exercises with an "expander" with a traction of 100 pounds. During this exercise he suddenly felt a stab in the right shoulder and chest, everything went black to him, and he was about to collapse. When he had straightened up a little he complained of intense pain, indisposition and dyspnea, and he had to sit up throughout the night. During the following day he was confined to bed, but after 5 days he felt so much better that he wanted to go to a movie. On the way to the movie, however, he had a new attack of pain in the right shoulder, chest and arm, he became markedly dyspneic, and collapsed. He was admitted to the hospital.

On admission, he was moribund. A large exudate was found in the right pleural cavity. At first he improved somewhat, but 7 days later he again had a sudden attack, with increasing swelling of the right supraclavicular and infraclavicular regions, and he died.

Autopsy revealed a circular complete rupture of the right subclavian artery, 3 cm. from its origin from the anonymous artery, near the margin of the first rib. A false aneurysm protruded into the pleural cavity at the apex, and here it had perforated. The right pleural cavity contained nearly  $4\frac{1}{2}$  l. blood, partly fresh, partly old, with displacement of the heart and diaphragm, besides a rupture of the diaphragm posteriorly. The retroperitoneal tissue on the right side was imbibed with blood, and lymph nodes at the psoas showed absorption of blood. Microscopic examination appears not to have been performed.

These two cases have some points of marked resemblance in the origin of the arterial rupture as well as in its site. Furthermore, it is hardly accidental that the rupture is located in the vicinity of the first rib. The motions to be considered in this connection are associated with a very powerful contraction of the musculature of the shoulder girdle together with the contraction of the abdominal wall. This brings the chest into the position of maximal inspiration, by which the diaphragm is flattened, and the heart thus is placed at a lower level. This brings about a tension and stretching of the vascular trunk. As presumably neither of the patients has been left-handed, they contract preponderantly the muscles on the right side, elevating in particular the superior aperture of the chest and thus the first rib. The subclavian artery, being already stretched over the first rib as a result of the traction exerted by the heart, is thus pinched between the clavicle and the first rib. Furthermore, the blood pressure is increased as a result of the exertion.

In a casuistic report by ROWNTREE in 1920 it was mentioned

that the subelavian artery actually may be pinched between the clavicle and the first rib. He described an instance of rupture in the subelavian artery in a very muscular man, 48 years old, who had to hurry in opening a water-gate during rising water. While doing this he suddenly had intense pain in his right arm, which became powerless, but no swelling. 5 weeks later, when the author saw the patient, the right arm was cold and pale. All motions could be performed, but there was no perceptible radial pulse. 4 months later the radial pulse could be felt but it was weaker than that of the other side. Two years later the pulsation was stronger, although weaker from the middle of the brachial artery upwards. There was no sign of any aneurysm. ROWNTREE thinks that an incomplete rupture of the subelavian artery arose at the site where this vessel crosses the first rib, and he ascribes the rupture to the strong muscular contraction that brings the clavicle in close contact with the first rib, thus pinching the artery.

In his own experiments ROWNTREE found that cessation of the radial pulsation is brought about temporarily by contraction of the muscles of the shoulder in such a position as is found, for instance, on lifting a heavy sluice-gate, but he does not know whether this is a general rule or it merely depends on some particular structure.

I have reproduced his experiments on several of the staff members in this department, letting them lift a heavy load up above their head, and I found that during this action the radial pulse became weaker or even disappeared completely.

Thus there can be no doubt that such forced movements are associated with a stretching of the subelavian artery together with a compression. But this in itself is not enough to explain the rupture. HANF-DRESSLER emphasizes the "athletic heart" in the overtraining man and speaks about the "exhausted wall of the vessel". This explanation appears rather constructed, but probably no better can be offered now.

In our own patient the blood vessels were strikingly fragile. This was noticed already at the time of the blood transfusion, when the veins in the bend of the elbow and the great saphenous vein were so thin-walled and fragile that they kept breaking continuously, and this cannot be due to the collapse alone. Furthermore, the vascular hypoplasia was noticed at the autopsy and at the histological examination, so that a constitutional vascular fragility unquestionably was present in this patient.

This is further suggested by the striking frequency of epistaxis in our patient, often without any extraneous cause. Now a great many persons are subject to nosebleed, it is true, but it still is a striking fact that many of the patients who have died from spontaneous rupture of blood vessels were troubled in a marked degree with epistaxis. This applies, besides the case of HANF-DRESSLER, also to a case reported by WASASTJERNA (1903) of spontaneous rupture of the aorta in a boy, 13 years old, who was a very ardent skater, and to a case reported by KUROSAWA (1917) of spontaneous rupture of the intracranial part of the internal carotid artery in a woman, 48 years old, who was troubled not only with nosebleed but also with very profuse and protracted menstruation.

As to the *treatment* of rupture of the subclavian artery — if this be recognized in time — it will consist most often in ligation, as there will hardly ever be time enough for suturing of the blood vessels. The artery should be approached through a longitudinal incision, and, if necessary, the clavicle may be divided — as has been done indeed in a couple of cases (ZIEGLER 1899, KLOSSNER 1936).

In most cases this will give some prospects of saving the arm. According to WOLFF (1908) ligation of the subclavian artery is followed by gangrene of the arm only in 4.8 % of the cases. Here the collateral circulation is far more abundant than in the lower extremities. It is important to remove the extravasated blood to promote the development of the collaterals. Whether the subclavian vein should be ligated at the same time as the artery, is still an open question. A few authors advise against this measure, and some hold that it makes no difference, whereas LERICHE and many others emphasize that it ought to be done. It acts like a masked sympathectomy — as claimed by LERICHE & FONTAINE (1930) — and this view also finds support in the figures given by WOLFF, showing that ligation of the artery alone is followed by gangrene of the upper extremity in 7.8 % of the cases, while ligation of the vein as well as the artery gives no gangrene.

### Summary.

While lifting a box up above his head, a young man, 16 years old, had a sudden attack of pain in the right shoulder. 6 days later the patient fainted in the morning. Now he was strikingly

pale, and a large swelling was noticed on the right side of his chest. On admission to the hospital he was extremely exhausted with anemia, and in spite of blood transfusion he died 6 hours later. At the transfusion his veins were found to be strikingly fragile.

Autopsy revealed a large hemorrhage into the soft parts round the right shoulder. The starting-point of the hemorrhage was found to be a rupture of the right subclavian artery. The connective tissue and vascular tissues, in the veins as well as in the arteries, were very hypoplastic.

The rupture is attributable to a combination of a mechanical factor and a disposition to abnormal fragility of the vessels. This view finds support in the literature and the writer's experiments.

The treatment of this injury will mostly consist in ligation, as usually there will not be time enough for suturing of the vessel. The rupture is approached through a longitudinal incision, and, if necessary, the clavicle has to be divided.

Ligation of the subclavian artery is followed by gangrene of the arm in 4.8 % of the cases. It is important to remove the extravasated blood, so that the collaterals may develop. According to LERICHE and others, the subclavian vein should be ligated at the same time.

### Zusammenfassung.

Ein 16jähriger Jüngling bekam beim Heben eines Sackes plötzlich Schmerzen in der rechten Schulter. 6 Tage später wurde der Patient eines Morgens ohnmächtig; er war nun auffällig blass, und man bemerkte an der rechten Seite der Brust eine grosse Schwellung. Bei der Aufnahme hatte man einen äusserst elenden, anämischen Kranken vor sich, der trotz Bluttransfusion 6 Stunden später starb. Bei der Transfusion bemerkte man eine auffällige Schwäche der Venenwandungen.

Legalsektion ergab eine grosse Blutung in den Weichteilen in der Umgebung der rechten Axille. Als Ausgangspunkt fand man einen Riss der rechten Arteria subclavia. Das Bindegewebe und das Gewebe der Gefässe, sowohl der Arterien als auch der Venen, war überaus hypoplastisch.

Die Ursache der Zerreissung dürfte durch eine Kombination eines mechanischen Faktors und einer Disposition zu abnormal

zerreisslichen Gefässen zuzuschreiben sein. Dies wird durch Literaturstudien und eigene Versuche gestützt.

Die Behandlung der Subklaviaruptur wird zumeist in einer Unterbindung bestehen, da man wohl selten Zeit haben wird, eine Gefässnaht vorzunehmen. Ein Längsschnitt ist anzulegen und das Schlüsselbein im Bedarfsfalle zu durchsägen.

Nach Unterbindung der Arteria subclavia tritt nur in 4.8 % der Fälle eine Gangrän des Armes auf. Wichtig ist, den Bluterguss zu entfernen, so dass Kollateralen zur Entwicklung kommen können. Nach LERICHE u. a. ist gleichzeitig die Vene zu unterbinden.

### Résumé.

Un jeune homme de 16 ans ressentit une douleur soudaine dans l'épaule droite en soulevant une caisse au travail. Six jours après il s'évanouit un matin; il était à ce moment d'une pâleur frappante, et l'on remarqua une grosse tuméfaction du côté droit de la poitrine. A l'hospitalisation, on se trouva en présence d'un malade anémique, en état général extrêmement misérable, qui en dépit d'une transfusion sanguine, mourut 6 heures plus tard. Lors de la transfusion on avait remarqué la friabilité des veines.

L'autopsie médico-légale montra une grande hémorragie autour de l'aisselle droite. Son point de départ fut découvert dans une rupture de l'artère sous-clavière droite. Le tissu conjonctif et celui des vaisseaux, tant des veines que des artères, était très hypoplasie.

La cause de la rupture doit être attribuée à la combinaison d'un facteur mécanique avec une friabilité anormale et préexistante des vaisseaux. Cela est corroboré par des recherches bibliographiques et des essais personnels.

Le traitement de la rupture de la sous-clavière consistera généralement en sa ligature, étant donné qu'on n'aura que rarement le temps de pratiquer une suture vasculaire. Il faut arriver au vaisseau par une incision longitudinale, et scier la clavicule si nécessaire.

Après ligature de la sous-clavière la gangrène du bras ne survient que dans 4.8 % des cas. Il est important d'enlever le sang épanché, afin de permettre à la circulation collatérale de se développer. Selon LERICHE et d'autres auteurs on doit lier en même temps la veine.

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## Cat Bite — Pasteurellosis — Halisteresis.

By  
O. KAPEL.

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It seems rather strange that the writer should be the only surgeon in the Scandinavian countries who has been faced by the not insignificant — and often even serious — lesion produced in man by cat bite. As far as I know, my previous papers on this subject are the only ones published so far in the Scandinavian literature on this lesion.

This paper is published not so much because the case reported below really brings anything new, the clinical picture of the lesion being rather stereotypical in many cases. But in the present case, which I met with quite accidentally, the lesion took a relatively serious course. Furthermore, in the *Journal of Bone and Joint Surgery*, 1931, p. 161, I have found an article by H. TURNER, describing 2 cases which, according to my previous experiences, have to be entered under the above-mentioned category even in the absence of bacteriological data. As TURNER has interpreted the clinical features in an altogether different manner, it seems appropriate here to mention these cases in relation to pasteurellosis, as its clinical picture is quite in accordance with my observations in this field.

The history of my own case is as follows:

The patient was a woman, 44 years old, admitted to Dep. H of this hospital (Record No. 1929/43) on July 27th, 1943.

Two days before admission the patient had been bitten in her finger by her cat. In the course of the day the finger became painful and swollen. The temperature rose to 38.5°. A sulfonamide treatment was ineffective.

On admission the entire index finger was swollen; a bite was seen both on the volar surface and the dorsal. The patient was given tetanus

antitoxin. Roentgenography was performed on the following day. A small amount of puriform fluid was aspirated from the finger. During the following days there was an increase in the swelling and pain, involving the entire finger. One week after admission, roentgenography showed a narrowing of the joint gap in the middle joint. Arthrotomy was performed, with drainage. A sulfonamide treatment (Chemosept) was given ever since the admission, a total dose of 32 g.

One week later ( $14/8$ ), on account of persistent swelling of the finger and purulent discharge, a new incision was made, revealing denuded bone.

Two weeks later the patient was discharged from the hospital temporarily; but on account of persistent severe pain she was readmitted 4 days later, and the finger was exarticulated in the metacarpophalangeal joint, together with resection of the distal third of the corresponding metacarpal bone.

The roentgenogram taken prior to the operation is shown in Fig. 1. A few days later the patient was discharged for further treatment by her private physician.

*Bacteriological Examination of Pus by the State Serum Institute:*

Pure culture of non-motile Gram-negative rods.

Fermentation of xylose, saccharose, glucose and mannitol.

The following sugars were not fermented: adonit, dulcite, sorbite, arabinose, rhamnose, maltose, salicin and lactose.

Indole formation +.

No growth in yeast water.

The bacteria are killed by 2.5% and 1.25% taurocholate, but not by 0.6%.

(Signed: A. Reyn.)

Here then we are dealing with a very typical case of human pasteurellosis. Undoubtedly the pathogenesis in this case is the same as emphasized by me previously: the infection introduced primarily into the bone, is allowed to develop in pure culture so that the process through swelling, tenderness and halisteresis goes on to the complete destruction of the bone — often so extensive that effective surgical treatment comes too late to save the finger. Sulfonamide appears not to have been particularly effective in this case.

In the present case as well as in the previous cases I have observed, the characteristic features have been intense pain, lowered function of the fingers and wrist-joint, swelling, redness and oedema, not only round the site of the bite but also of the dorsal aspect of the hand, wrist and, often, forearm (Nord. Med. 1942). This, in turn, leads on to pronounced halisteresis of the metacarpal bones and fingers, partly because the wrist and fingers are kept



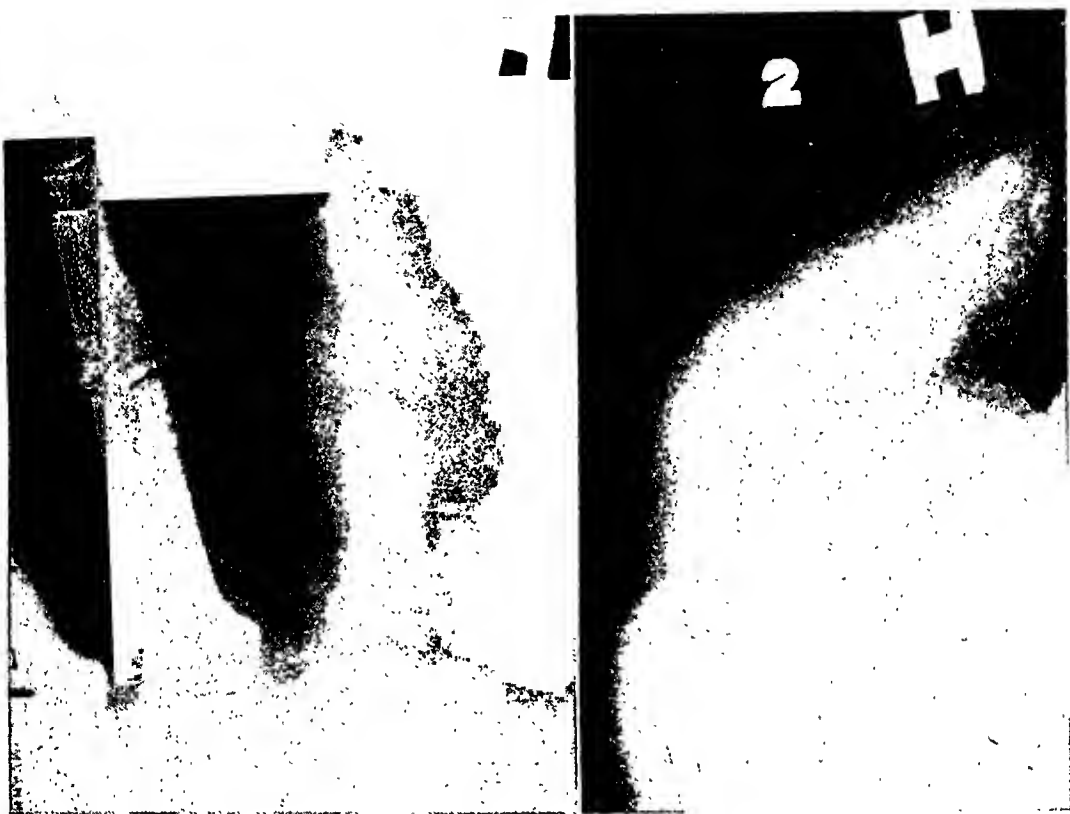


Fig. 1.

KAPEL: Cat Bite — Pasteurellosis — Halisteresis.



immobile on account of pain, partly on account of the absorption of bone due to the infection itself. (In a case of cat bite in an elderly woman admitted to my department these symptoms were particularly pronounced. This case was not published as no incision was made — and hence no bacteriological examination.)

After this it will be appropriate briefly to consider the above-mentioned two cases reported by TURNER. One patient had been bitten in the hand by a cat one month before admission. The other patient had been bitten 4 months before admission.

On admission there were pain and swelling of the dorsal aspect of the hand, stiffness of the fingers and wrist-joint; oedema of the forearm. Roentgenography showed decalcination of the lower part of the radius, metacarpal bones and phalanges. There was no abscess formation, and no incision was made, on which account there was no bacteriological examination. These phenomena subsided in the course of 4 months. TURNER interpreted them as due to injury to the end branch of the radial nerve. In other words, he supposed this nerve to be hit by the cat bite, attributing the symptoms observed to this injury, and TURNER explains these symptoms as neurotrophic disturbances.

As is well known, in lesions associated with protracted oedema and pain we meet with phenomena which we have to attribute to neurotrophic factors, in the upper extremities as well as the lower. In the present case, however, the etiology and clinical features, which TURNER describes step by step, exactly like those described by me and several other authors. In both of these cases, however, the course of the lesion, even if protracted, has still been of a milder character than in most other cases of this kind, so that no material for bacteriological examination has been available.

It seems rather unnatural and improbable that a cat bite in two cases observed by the same surgeon should have hit just the very end branch of the radial nerve that innervates the bones and joints mentioned. As furthermore various authors have described an etiologically parallel clinical picture with definite bacteriological findings, there seems to be every reason to think that TURNER has interpreted the lesion of his two patients as mentioned above merely because he was not acquainted with this phenomenon.

I am indebted to Dr. H. Wulff, Surgeon-in-chief, Dep. H. of this hospital, for permission to publish the present case.

### Summary.

Mention is made of a new case of ostitis produced by pasteurellosis following a cat bite.

A review is given of two undoubtedly similar cases reported in the American literature but interpreted differently.

### Zusammenfassung.

Ein weiterer Fall von Pasteurellosis wird erwähnt. 2 andere Fälle in amerikanischer Literatur werden erwähnt.

### Résumé.

Mention d'un cas nouveau d'ostéite produit par pasteurellosis après la morsure d'un chat.

Un récit est donné de deux cas sans doute pareils mentionnés dans la littérature américaine, mais expliqués différemment.

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## A Study of New Bone Formation Provoked by Subperiosteal Injections of Blood Plasma, Extract of Bone Marrow, etc.: An Investigation by Experiments on Animals.

By

ARVID HELLSTADIUS.

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Many experiments have been made in order to provoke new bone formation by injecting various substances beneath the periosteum and into the sites of fractures. By these procedures it was intended to secure union of fractures with unsatisfactory callus formation and pseudarthrosis. It is also conceivable that by such injections periosteal new bone (*os novum*), to be used for transplantation, may be obtained. A great many different chemical substances have been tried without success. Some of these killed the cells within a considerable area, causing tissue necroses and thus directly injuring the tissue producing new bone. There was reason to expect better results from experiments made in order to provoke new bone formation by subperiosteal injections of blood, extracts of bone marrow and bone autolysates.

BIER was the first to inject blood. He stated that fractures with large haematomas usually heal well, whereas operated fractures, where the haematoma was evacuated on operation, and compound fractures, in which the blood had flowed out through the perforated skin, as a rule show poor callus formation. He also pointed out that from a blow on the tibia followed by a haematoma a thickening of the bone at the site of the trauma sometimes results. All these facts constitute, according to BIER, evidence in favour of the haematoma stimulating new bone

formation. BIER performed repeated injections beneath the periosteum covering the ends of the fractured bone in cases of unsatisfactory callus formation or pseudarthrosis, and considered, as well as several other authors, the results obtained by this procedure to have been satisfactory. Other investigators, however, were of a contrary opinion. LEXER, HILDEBRAND and others thought that the haematoma in fractures did not exercise a stimulating influence on new bone formation, and that injections of blood round the fracture ends proved detrimental rather than beneficial. These authors claimed that the often unsatisfactory new bone formation in operated and compound fractures was not due to the haematoma being absent, but to the comparatively extensive laceration and traumatization of the soft tissues — above all, in fractures of this kind, of the periosteum covering the fracture ends. In experiments on animals new bone formation within the periosteum occurs if blood is injected beneath the latter (BUCKHARDT). According to BERGEL, it is the fibrin of the blood that is responsible for the irritation leading to new bone formation, whereas the red corpuscles and the serum do not participate in this process. BERGEL injected, in animals, an emulsion of fibrin beneath the periosteum and obtained new bone formation. Even in man, in cases of fractures with delayed union and pseudarthroses, BERGEL made repeated injections of fibrin emulsion, reporting gratifying results. At the present time injections of blood or fibrin emulsion are rarely used in the treatment of poorly-healing fractures, surgery of one kind or another being generally preferred. On the other hand, blood injections have not been altogether abolished. Thus, even during the last years a few authors (*e. g.* CSKY-STRAUSS) claimed to have obtained good results with this method of treatment.

BUCKHARDT states that he has injected subperiosteally extract of bone marrow, and that he has provoked new bone formation by this procedure. He also injected marrow extract into gaps after resections of bone and observed a stimulating influence upon bone formation. I have, however, not been able to find more detailed data published by BUCKHARDT concerning his experiments on animals.

HENSCHEN tried to induce new bone formation by injecting autolysates of bone. By repeated injections of this kind beneath the periosteum covering the diaphysis, he obtained in rabbits a considerable production of new bone on the surface of the dia-

physis. In the same way he injected liver autolysate; this, however, did not result in new bone formation, but only in the development of hyperplastic periosteal scars. In his opinion, autolysates are tissue-specific. Thus solely autolysates of osseous tissue, not those of other tissues, would provoke new bone formation. Conversely to HENSCHEN's observations, HEMPEL after injections of bone autolysate found very little, if any, deposition of new bone, in his opinion due to the mechanical effect of the injection.

According to the experiments on animals hitherto carried out, both blood and extracts of bone marrow, when injected subperiosteally, thus will give rise to new bone formation, whereas on the other hand the statements as regards bone autolysates are controversial in this respect. It is doubtful whether these substances also stimulate new bone formation around fractures. More extensive clinical experience has been gained only from injections of blood (and of fibrin emulsion) in cases of fractures with delayed union and pseudarthroses. As this method, however, by now has been generally superseded by surgery of one kind or another, the conclusion appears justified that as a rule the results of blood injections have not been particularly gratifying. As to the marrow extracts, there is only the statement of BUCKHARDT, according to which this author observed a stimulating influence on the callus formation in experimental fractures, but, as pointed out above, I was not able to find more detailed data for these experiments.

In my experiments on animals performed in order to provoke new bone formation by subperiosteal injections of blood plasma, marrow extract, etc., initially repeated injections directed against the cortical bone were carried out, and the new bone formation was studied. Control experiments were made in the same way, viz. injections of normal saline alone. Subsequently injections round fracture ends and bone transplants were carried out in order to investigate the effect on the callus formation, which possibly might result. The animals used in the experiments were full-grown rabbits.

### Subperiosteal Injections.

The subperiosteal injections were made on the anterior medial surface of the tibia, as a rule at intervals of 3 to 4 days. After a

certain time the animal was killed; the bone, on which the injections had been made, was removed for roentgenography and afterwards cut into sections for histological examination. The sections were taken from those areas, in which the palpable thickening of the periosteum was most bulky, and, consequently, also the osteoid deposit.

Repeated injections of ordinary blood have the disadvantage that the blood cannot be stored without coagulating; for this reason fresh blood must be procured for each injection. In order to preclude coagulation, I have therefore added citrate solution. In my experiments blood plasma was used exclusively. Injections of whole blood lead to the soft tissue being infiltrated by blood corpuscles and becoming discoloured. If the blood corpuscles are irrelevant as to the stimulation of callus formation, as stated by BERGEL, they may as well be separated from the plasma by centrifuging and removed. In order to establish further that this conception is correct, I have in *Exp. 1* compared the results of repeated subperiosteal injections of citrate blood on one tibia with those of simultaneous injections of the identical amount of plasma in the corresponding place on the other tibia. The bones, on which the injections were made, were removed for histological examination after 2 weeks. On both, formation of new osteoid tissue was observed, the thickness of which being the same on the right as on the left side. Where the new bone produced was thickest its height corresponded to  $\frac{1}{4}$  of the thickness of the cortical bone. Thus, plasma stimulated new bone formation to about the same extent as citrate blood. In the following experiments I therefore used *citrate plasma* instead of whole blood.

When subperiosteal injections are made, the insertion of the hypodermic needle and the injection of the fluid cause some traumatization of the periosteum. As it was conceivable, in view of the generally very considerable new bone formation propensity of rabbits, that this repeated mechanical irritation of the injections as such might give rise to a certain amount of new bone formation, in *Exp. 2* repeated subperiosteal injections of plasma were made on one tibia and, simultaneously, injections of the same amount of normal saline on the other. After 18 days, when the animal was killed, a thickening of the bone could be felt on both sides, but on the side where saline had been injected it was more bulky than on the other side treated with plasma. Histologically, formation of new osteoid tissue was observed,



which on the saline side was twice the thickness of the cortical bone (Fig. 1), whereas on the plasma side its thickness was about the same as that of the cortical bone.

Subsequently experiments were carried out with *extract of bone marrow*. The marrow was taken from the diaphyses of long bones and extracted with normal saline. The extract was stored in a refrigerator.

In *Exp. 3* repeated subperiosteal injections on the tibia of one side were made with marrow extract, the identical amount of normal saline simultaneously being injected in the corresponding area of the opposite tibia. After 17 days the bones were removed for examination. There were deposits of osteoid tissue on both bones, although the deposit on the side where marrow extract had been injected was considerably thicker — more than thrice the thickness of the cortical bone (Fig. 2) — than on the other side treated only with saline, viz. here nearly as thick as the cortical bone.

In order to compare the new bone formation effects of marrow extract and plasma, in *Exp. 4* repeated subperiosteal injections of marrow extract were made on the tibia of one side and simultaneous injections of the identical amount of plasma on the opposite tibia. After 2 months the bones were removed for examination. It was then found that on the side where marrow extract had been injected a deposit of osteoid tissue had developed, which within the area of its maximum bulk was about half as thick as the cortical bone. On the opposite side where plasma had been injected, there was but inconspicuous (less than  $\frac{1}{5}$  of the thickness of the cortical bone) formation of new osteoid tissue.

HENSCHEN and HEMPEL, as mentioned above, used *autolysates* of osseous tissue. In this case hard osseous tissue can scarcely be considered to exercise any influence, the autolytical products instead being derived from the soft bone tissue, i. e. above all from the marrow. For this reason I used marrow autolysate. The marrow, as in the case of the marrow extracts, was taken from the diaphyses of long bones. The autolysis was allowed to take place in a thermostat. Autolysates differ from extracts in that respect that in the former autofermentative disintegration of proteins has occurred; autolysates therefore contain decomposition products of proteins.

In *Exp. 5*, on one side repeated injections of marrow autolysates were made and, simultaneously, on the other, of the identical

amount of normal saline. After 17 days the bones were removed for examination. Deposits of osteoid tissue were found on both sides. The deposit on the side, however, where only saline had been injected, was thin ( $\frac{1}{3}$  of the thickness of the cortical bone), whereas on the autolysate side it was twice as thick ( $\frac{2}{3}$  of the thickness of the cortical bone).

LERICHE has described a specific oedema appearing in the soft tissues surrounding the fracture on the 4th to 5th day after the accident, which, in his opinion, is of decisive importance for the callus formation. This specific oedema, according to LERICHE, develops at all sites of new bone formation, and there is no new bone formation without oedema. I decided to investigate whether extract of such muscular tissue might contain substances stimulating new bone formation. From curettage of the periosteum covering the diaphysis results, in rabbits, without exception a certain amount of new bone formation on the osseous surface (MACEVEN, ALBERT). In preceding experiments on animals, in which I provoked new bone formation by curetting the periosteum, I found the adjacent musculature to be pale and oedematous, an oedema obviously identical with the fracture oedema described by LERICHE. In this way I secured the oedematous muscular tissue, which I subsequently extracted, in order to inject the extract beneath the periosteum. Below this will be referred to as *muscular tissue with "fracture oedema"*.

Before going on to discuss experiments with extract of muscular tissue with "fracture oedema", there is reason to ascertain whether or not extract of normal muscular tissue provokes new bone formation. BUCKHARDT reports that he has made experiments by injecting subperiosteally extract of normal muscular tissue, thereby obtaining only very slight, if any, new bone formation. In *Exp. 6* repeated subperiosteal injections of ordinary muscle extract were made on one tibia, whilst simultaneously the identical amount of normal saline was injected on the other. The bones were removed for examination after 17 days. On both tibiae swellings of about the same bulk were detected on palpation, and histological examination revealed also periosteal new bone formation, being actually somewhat thicker on the side where saline had been injected (viz. as thick as the cortical bone), than on the other side treated with muscle extract.

In *Exp. 7* the periosteum was removed from one radius diaphysis by means of a sharp raspatory. After 2 weeks the oedem-

atous musculature covering the area where the periosteum had been curetted was excised and extracted with normal saline. Repeated subperiosteal injections of this extract were made on the tibia of one side, at the same time the identical amount of normal saline being injected subperiosteally on the opposite tibia. 10 days after the first injection the bones were removed for examination. On the side where saline had been injected new bone formation was absent. On the other side, however, viz. that treated with extract, a deposit of osteoid tissue was found on the bone, which at the point of its maximum bulk had a thickness of  $\frac{1}{3}$  to  $\frac{1}{2}$  of the cortical bone.

In *Exp. 8* extract was injected similarly, apart from the oedematous musculature having been excised for preparing the extract as early as after one week. 1 week after the first injection a periosteal deposit could be felt, which afterwards increased in size. After 2 weeks the bone was removed for examination. The tibia showed a periosteal deposit of osteoid tissue being, at the point of its maximum bulk, as thick as the entire cortical bone.

In *Exp. 9* it was investigated whether by boiling the extract its capacity to stimulate new osteoid tissue formation was impaired. The extract was prepared in the usual way from muscular tissue with "fracture oedema" excised after 1 week. A portion of the extract was boiled. Later repeated subperiosteal injections of the boiled extract were made on one tibia and, simultaneously, of the identical amount of the extract not boiled on the other. After 3 weeks the bones were removed for examination. The deposits of osteoid tissue on both sides were of about the same thickness. At the point of their maximum bulk the deposits were considerably thicker than the entire cortical bone.

From the experiments detailed above it will be seen that repeated subperiosteal injections of blood plasma, marrow extract and marrow autolysate give rise to new osteoid tissue formation on the surface of the bone. The same applies not only to extract of muscular tissue with "fracture oedema", but also to extract of normal muscular tissue. Furthermore, repeated injections of normal saline alone as a rule provoked new osteoid tissue formation, the layers of which in certain cases attained a very considerable thickness (cf. *Exp. 2* and *Exp. 3*). This production of new osteoid tissue after injections of normal saline is probably due to the traumatizing effect of subperiosteal injections. In certain cases such deposits could attain the same bulk as in other in-

stances achieved by injections of tissue extract and marrow autolysate. The thickness of the deposits in the individual cases showed rather well-marked variations, and this circumstance implies that cases where blood plasma was injected on one side and normal saline on the other, the new tissue formation was more extensive on the saline side than on the plasma side; consequently, the interpretation of these differences as due to varying degrees of traumatization at the injections readily suggests itself. Moreover, for this reason it is difficult to form an opinion concerning those instances where normal saline has been injected on one side and marrow extract, etc. on the other, in order to compare the effects. Under such conditions it must be considered doubtful whether the extracted substances contained in the extracts play any part at all in the production of new osteoid tissue, and whether the effect of the injections of these extracts may not be due solely to the traumatization by the injections. In those cases however, where marrow extract, marrow autolysate or extract of muscular tissue with "fracture oedema" had been injected on one side and normal saline on the other, there was less osteoid tissue formation on the latter side.

### Experiments in Order to Provoke Formation of Calcified Periosteal New Bone by Injecting Plasma and Marrow Extract on Damaged Cortical Bone.

In none of my experiments described above skiagraphically visible calcification of the osteoid tissue was obtained. According to WILTON, for deposition of calcareous matter within osteoid tissue to occur it is essential that the cells of this tissue have attained a certain degree of maturity or differentiation. This is also supported by FELL and ROBISON's investigations showing that immature bone cells are not able to produce the enzyme phosphatase necessary for the deposition of calcareous matter.

In other experiments I have found that, after osteotomies performed in the radius of the rabbit, calcification within the osteoid callus is skiagraphically apparent after but 2 to 3 weeks. My above experiments with subperiosteal injections of plasma, marrow extract, etc. extended over up to 2 months, without traces of calcification in the osteoid tissue being visible in the radiograms. This, provided that greater age of osteoid tissue also implies increased

differentiation of its cells, cannot be due to lack of maturity as regards the cells of the osteoid tissue.

In this respect even other factors play a part, *e. g.* the osteoid tissue receiving a sufficient amount of those substances building up the hard bone, viz. above all calcium and phosphorus. It has been argued on which ways these substances are conveyed to the callus tissue of fractures. One of the possibilities is that they are transferred via the blood, viz. originating from the food or the skeletal system. Another is that they are taken directly from neighbouring osseous tissue. This question has been elucidated, as to the calcium, by experiments on animals performed by SEGOVIA. After having fractured a bone of an extremity, this author, when the callus had developed, removed the fractured bone as well as the corresponding bone on the opposite side. It then emerged that the amount of calcium in the fractured bone including the callus did not exceed that in the not fractured bone. Similar investigations were subsequently carried out by HÄBLER and REISS, who were able to confirm the results obtained by SEGOVIA. From this it will be seen that the calcium of the callus is taken from the fractured bone. LERICHE and JUNG have shown that *os purum*, when implanted into soft tissues, decreases in weight, and that the calcium content of the adjacent soft tissues rises to 90 mg%. Direct diffusion, therefore, of calcium salts into the surrounding tissues takes place. Thus, if the experiments of SEGOVIA and of HÄBLER and REISS prove that the calcium is derived from the fractured bone, from the experiments of LERICHE and JUNG the conclusion can be drawn that the calcium is not conveyed from the fractured bone to the osteoid callus via the blood, but that there is, instead, a direct diffusion of calcium from the fracture ends into the adjacent osteoid callus.

In my experiments specified above, in which new osteoid tissue formation was provoked by repeated subperiosteal injections of marrow extract, etc., without deposition of roentgenoparent callus within the osteoid tissue, the subjacent surface of the cortical bone was uninjured, apart from the comparatively slight traumatization caused by the point of the hypodermic needle at the injections. I therefore considered the possibility that this might not lead to decomposition of calcium salts in the hard osseous tissue, and that consequently deposition of calcareous matter did not appear in the skiagrams because of insufficient supply of calcium salts and other constituents of the hard bone. For this

reason I made in some experiments repeated injections of marrow extracts as well as of plasma on damaged cortical bone.

Before describing this part of the investigation more in detail, I will, *en passant*, give a report on a few experiments showing that the marrow is highly material for periosteal new bone formation. These experiments had, at that time, suggested to me that the marrow extract might be particularly suitable for investigations of this kind. In *Exp. 10* on both tibiae superficial lamellae of cortical bone were chiselled off from a portion of the median surface. In addition on one side a hole extending into the medullary cavity was drilled in the central part of this area. Through the opening a stiletto was inserted, with which the marrow was traumatized. Skiagrams made 4 weeks later showed a partly calcified periosteal deposit on the perforated bone, but none on the other side. The partly calcified deposit was about as thick as the cortex. In *Exp. 11* the same operation as in the preceding experiment was performed, the marrow, however, not being traumatized. When the animal was killed after 5 weeks, no periosteal deposition of calcareous matter was visible on either side. In *Exp. 12* the superficial stratum of the cortical bone was removed from a portion of one tibia, and in the central part a hole was drilled extending into the medullary cavity. By a stiletto inserted into the hole the marrow was traumatized. Skiagrams made 3 weeks later showed periosteal deposition of calcareous matter, which after 5 weeks had attained a height of 4 times the thickness of the cortical bone (Fig. 3).

Thus, if the superficial stratum of the cortex is removed with a chisel, no calcified periosteal deposition visible in the skiagrams is obtained; if, however, the cortical bone is perforated as far as the medullary cavity, and if the marrow is traumatized, a very considerable deposition of this kind develops. In the case, for example, of fractures, the marrow therefore must be material for the development not only of the intermediary but also of the periosteal callus. This was also pointed out by MARTIN (1920), who based his opinion on a number of experiments on animals.

In connexion with his experiments performed in order to provoke formation of *os novum* for transplantation, ORELL observed that when *os purum* was inserted beneath the periosteum of the tibia a more ample production of osteoid tissue on the surface of the bone resulted than when a wedge was taken from the tibia and implanted subperiosteally close to the bone defect caused by

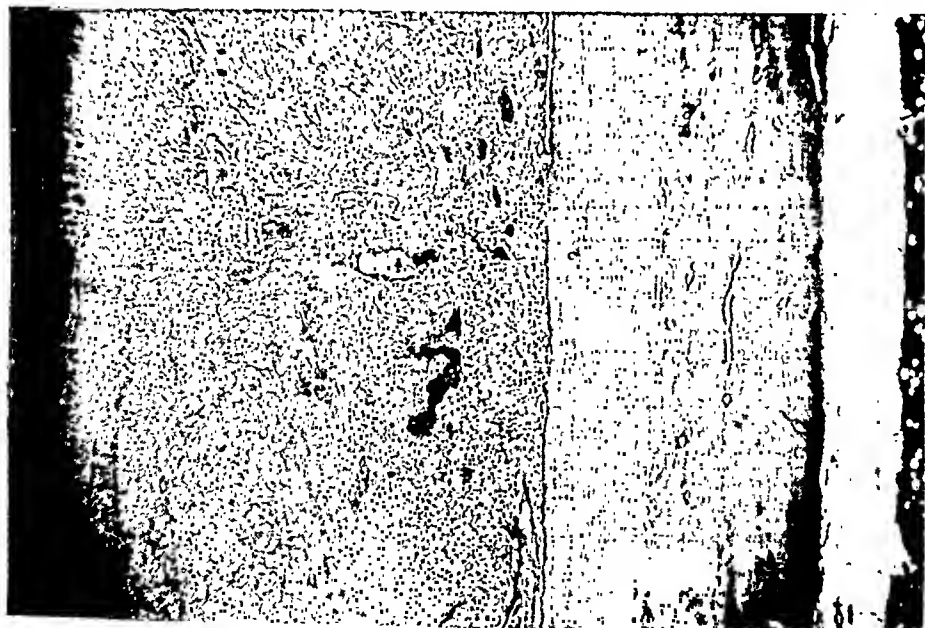


Fig. 1 (Exp. 2). New osteoid tissue formation after repeated subperiosteal injections of normal saline.



Fig. 2 (Exp. 3). Repeated subperiosteal injections with marrow extract has given rise to new osteoid tissue formation of considerable thickness.

the excision of the bone wedge. This, in his opinion, is probably due to the fact that in the latter case the new bone formation is principally required to fill up the bone defect in the tibia.

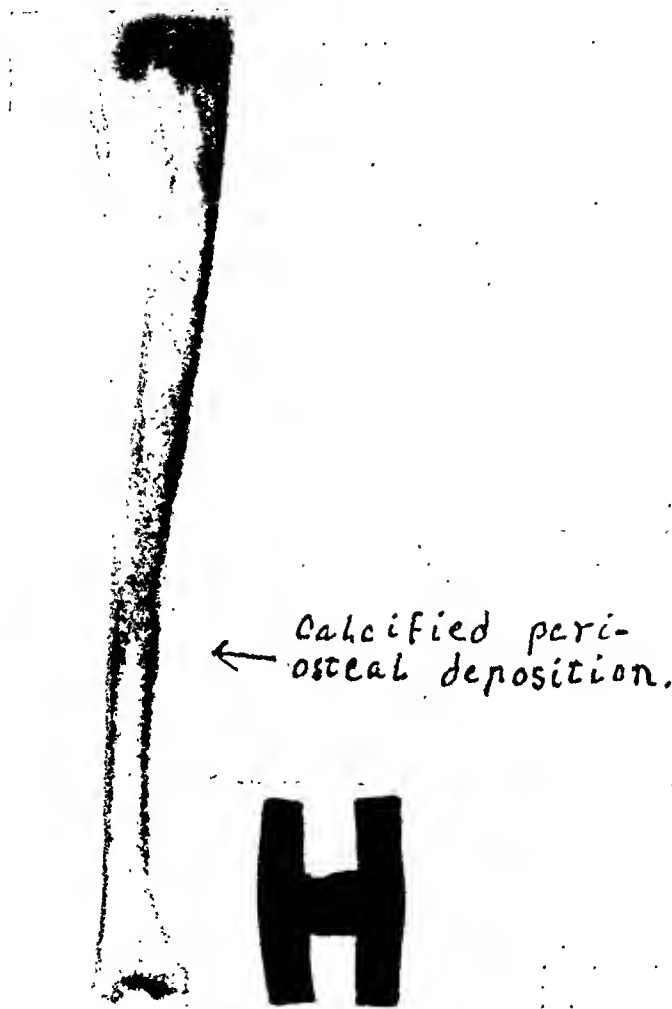


Fig. 3 (Exp. 12). A hole was drilled into the medullary cavity and the marrow was traumatized. A considerable periosteal deposition develops. The traumatized marrow stimulates periosteal callus formation.

In my experiments with perforation of the cortex and traumatization of the marrow (Exp. 10 and 12), there was new bone formation with deposition of calcareous matter from the surface of the bone, attaining considerable bulk, especially in Exp. 12. By traumatizing the marrow new bone formation, much more abundant than was necessary for filling the little drill-hole in the cortex, was provoked. Consequently, the new bone formation



proceeds from the drill-hole along the surface of the cortex, producing a deposit of considerable bulk.

On the side where in my experiments only a superficial layer of cortical bone had been removed, the production of new osteoid tissue did not give rise to more conspicuous thickening of the bone. Thus, the new osteoid tissue formation would seem to develop only to the extent of filling the defect in the cortex, the new tissue not rising much over the surface of the bone. Neither is, for this reason, the formation of a roentgenoparent deposit on the cortex to be expected.

It is doubtful on which routes the marrow stimulates periosteal callus formation. It is conceivable that cells from the injured marrow grow forth through the drill-hole or the fracture in the cortex to the periosteal surface of the bone there to form a callus. It is also possible that from the marrow a substance is secreted, stimulating the cells on the surface of the cortex to new bone formation.

In my following experiments designed to provoke formation of calcified periosteal new bone by injections on damaged cortical bone, initially I therefore used marrow extract. In *Exp. 13* the periosteum on the median surfaces of both tibiae was curetted with a sharp raspatory in such a way that superficial lamellae of cortical bone were injured in addition. Subsequently repeated injections of marrow extract were made on one tibia in the area where the periosteum had been removed. After 3 weeks periosteal calcification appeared in the skiagram for the side where marrow extract had been injected, but not in that for the other side. When the animal was killed after 8 weeks, there was a considerable deposit of calcareous matter on the side where marrow extract had been injected, being, at the point of maximum bulk, twice as thick as the cortex. On the other side, however, where only the periosteum had been removed, but where no injections had been made, still no calcification was observed. In *Exp. 14* the periosteum was removed from one tibia, repeated injections of boiled marrow extract then being made. In a skiagram taken after a little more than 3 weeks, a periosteal deposit of calcareous matter was noticed, being twice to thrice as thick as the cortex. and after not quite 6 weeks it was 5 to 6 times as thick as the cortical bone (Fig. 4). In *Exp. 15* the periosteum on one tibia was curetted in the usual way, and afterwards repeated injections of marrow extract were made in this place as well as beneath the

periosteum within the corresponding area of the other tibia, where the periosteum was intact. In a skiagram taken after 4 weeks, on the side where the periosteum had been removed a periosteal calcareous deposit was visible, being twice as thick as the cortical bone. On the other side, however, where marrow ex-

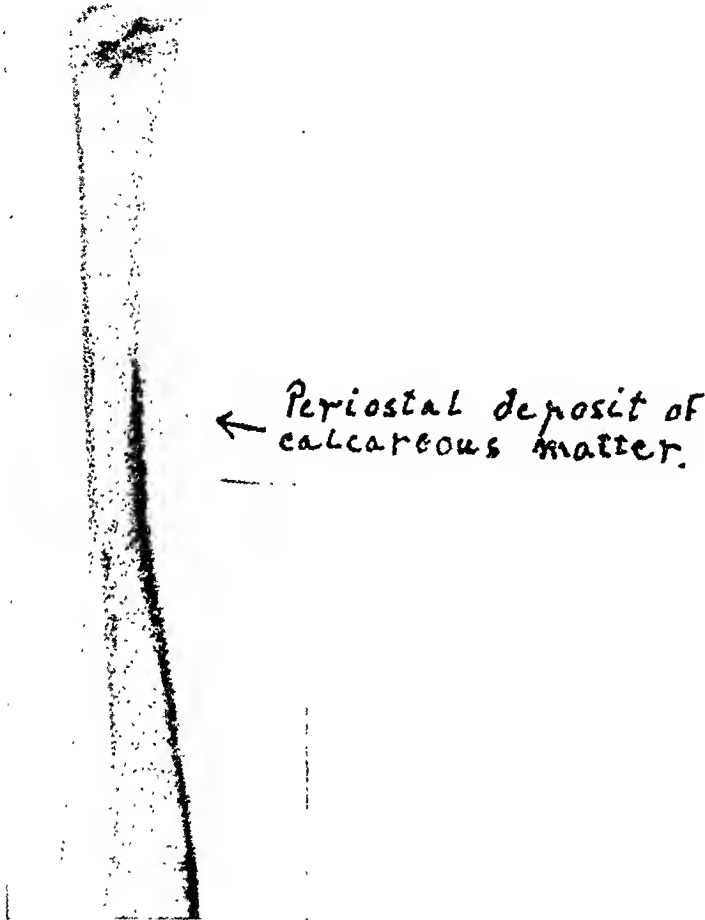


Fig. 4 (Exp. 14). Repeated injections of marrow extract on damaged cortical bone. Periosteal calcification appeared in the skiagram.

tract had been injected beneath uninjured periosteum, there was no calcification. The histological examination revealed formation of new bone being, on the side where the periosteum had been curetted, 4 times as thick as the cortex (Fig. 5 a); on the other side its thickness amounted only to  $\frac{1}{3}$ — $\frac{1}{2}$  of the cortical bone (Fig. 5 b).

Thus, from injections of marrow extract on damaged cortex, contrary to injections beneath intact periosteum, there resulted calcification of the newly-formed osteoid tissue. In addition, in

the former instances the new osteoid tissue formation was considerably more ample than in the latter. The difference was so great that it cannot readily be accounted for by possible variations in the mode of injection on both sides.

In *Exp. 16* the procedure was the same as in *Exp. 13*, apart from plasma being injected instead of marrow extract. In the skiagram taken after 3 weeks a periosteal calcareous deposit was observed on the side where plasma had been injected, viz. 4 times as thick as the cortex, but none on the other side.

Consequently, not only did injections of marrow extract on damaged cortical bone give rise to roentgenoparent calcareous deposits being formed within the new osteoid tissue, but the same effect was obtained when blood plasma was injected.

In *Exp. 17* the periosteum on the median surfaces of both tibiae was curetted in the usual way. Subsequently repeated injections of normal saline were made on one tibia. The animal was killed after 4 weeks. There was no palpable thickening of the bone due to new osteoid bone formation on either side, nor were periosteal calcareous deposits visible in the skiagrams. In *Exp. 18* and *Exp. 19* the periosteum was curetted on the median surface of both tibiae. Afterwards repeated injections of normal saline were made on both bones. When the animals were killed after 4 weeks, both showed periosteal calcareous deposits on both tibiae, in one of the cases (*Exp. 18*) attaining nearly thrice the thickness of the cortical bone.

Thus, also from injections of only normal saline on damaged cortex a roentgenoparent calcified periosteal callus may result, being of about the same bulk as after injections of marrow extract or blood plasma.

Calcareous matter visible in skiagrams is deposited in the newly-formed osteoid tissue only after the cortex has been damaged. The injury to the bone gives rise to processes leading to dissolution of calcium salts and other constituents of the hard osseous tissue, these substances subsequently spreading by diffusion into the osteoid tissue where the calcium is once more precipitated. Even if no calcareous deposit whatsoever within the osteoid tissue, provoked by injections beneath intact periosteum of plasma, marrow extract, etc., can be detected in the skiagram, such a deposit may still be present, being, however, neither so abundant nor so extensive that it appears in the skiagram. For this reason it is also of interest to ascertain the calcium content of such osteoid tissue

by chemical analysis. I therefore in two experiments arranged for the amount of calcium contained in the osteoid tissue to be determined by chemical analysis, and compared the figures obtained with the calcium content in normal musculature of the same animals. For this purpose in *Exp. 20* repeated injections of plasma were made beneath the periosteum of the tibia. After 17 days the newly-formed *os novum* was removed and, in addition, a piece of normal musculature of the same animal for chemical analysis of the calcium content. In the osteoid tissue the lime content was, in % of the volume of the specimen, 0.3, and in the musculature, 0.03. In *Exp. 21* the periosteum was curetted on one tibia, whilst plasma was injected beneath the intact periosteum of the other. Subsequently repeated injections of plasma were made on the damaged tibial surface as well as beneath the periosteum covering the other tibia. After 3 weeks the new osseous tissue was removed from each tibia and, in addition, a piece from the musculature of the same animal. On chemical analysis the following figures were found for the lime content in % of the volume of the specimen: in the new osseous tissue formed on the bone where the periosteum had been curetted, 7.6; in the specimen taken from the bone with intact periosteum, 1.8; and in the muscular tissue, 0.06.

From these experiments it will be seen that the calcium content even in the osteoid tissue provoked by injections beneath intact periosteum, *i. e.* not giving rise to roentgenoparent calcareous deposits, was considerably higher than in surrounding soft tissues. Also during the development of such osteoid tissue the periosteum and the cortex are subjected to some damage due to the insertion of the hypodermic needle at the various injections. This damage has obviously been sufficient to cause diffusion of a certain amount of calcium salts into the osteoid tissue, having, however, been too slight to transpose calcareous matter to such an extent that the precipitation of calcium would manifest itself in the skiagrams.

### Experiments in Order to Provoke Calcification of the Osteoid Tissue by Injecting Ground Bone or Calcium-Phosphorus Solution.

I have investigated whether the addition of calcium salts in the form of ground bone prepared from *os purum* to the marrow

extract might stimulate the deposition of calcareous matter within the osteoid tissue. In *Exp. 22* boiled marrow extract together with ground *os purum* suspended in the latter was repeatedly injected beneath the periosteum of the tibia on one side, whereas on the other a suspension of ground *os purum* in normal saline was injected simultaneously. After 4 weeks the bones were removed for examination. In the skiagrams no trace of calcareous deposits could be detected on the bone on either side. Histologically, there was formation of new osteoid tissue on both sides, but the deposit was considerably thicker on the side where marrow extract + ground *os purum* had been injected — at the point of maximum bulk nearly twice as thick as the cortical bone — than on the other side treated with only *os purum* suspended in normal saline, being here, at the point of maximum bulk, not quite as thick as the cortex.

ROBISON and his co-workers immersed longitudinal sections of extremity bones taken from rabbit embryos and rachitic rats in a calcium-phosphorus solution of specified composition, thereby obtaining precipitation of calcium within some areas of osteoid tissue and of cartilage. Thus, under certain conditions calcification of osteoid tissue in a calcium-phosphorus solution containing certain ingredients can occur *in vitro*. I have used a calcium-phosphorus solution prepared according to ROBISON and his co-workers in order to investigate whether repeated injections of this solution into the periosteal osteoid tissue resulting from repeated injections of marrow extract would give rise to precipitation of calcareous matter within the tissue. In *Exp. 23* repeated subperiosteal injections of marrow extract were made on both tibiae. After 2 weeks, simultaneously with these injections of marrow extract, ROBISON's solution was injected subperiosteally on one side. The bones were removed for examination after 5 weeks. The skiagrams did not show calcification on either side. The osteoid deposit was on both sides as thick as the cortical bone.

Thus, it proved impossible to provoke roentgenoparent precipitation of calcium by supplying the osteoid tissue with the mineral components of bone in the form of ground *os purum* or ROBISON's calcium phosphorus solution. The biological and chemical processes responsible for the precipitation of calcium within the osteoid tissue are highly complicated and largely obscure in character, and it is perhaps not so very surprising that the process cannot be instigated solely by injecting the chemical con-

stituents of hard osseous tissue. Only by lesions of the bone cortex (cf. Exp. 13—16 and 18, 19) the biological processes leading to calcification of the osteoid tissue were provoked.

### **Injections of Plasma Directed against Free Transplants of Bone in Soft Tissues.**

When a piece of bone is implanted into soft tissue, as a rule osteoid tissue will develop on the surface of the graft. In the case of bone transplantation into "bone milieu", osteoid tissue is formed partly on the surface of the transplant in the same way as after implantation into soft tissues, and partly osteoid tissue originating from the osseous matrix, into which the graft has been inserted, proceeds on to the transplant. New bone formation in transplantation thus arises from two different places, and it can be taken for granted that both these sources of new bone formation play an important part for the result of bone grafting. Since repeated subperiosteal injections on a normal bone give rise to formation of new osteoid tissue on the surface of the bone, it is of interest to ascertain whether an increase of the new bone formation on the surface of a bone transplant can be achieved by injecting plasma beneath the periosteum of the graft. In two experiments (24 and 25) I have studied the effect of repeated subperiosteal injections on bone transplants inserted into soft tissues. A portion of the radius diaphysis was resected, and the transplant covered with periosteum thus obtained was divided transversely into two equal parts. One of these was implanted into the thigh musculature on one side, the other one on the opposite side. Repeated injections of plasma were made on one transplant. In one instance (*Exp. 24*) the grafts together with the surrounding soft tissues were removed for histological examination after 11 days, and, in the other (*Exp. 25*), after 25 days. Transversal sections were prepared from the central portion of each graft. In both experiments the results of the histological examination were identical. In sections from the grafts, on which injections had not been made, no deposits of osteoid tissue were observed, whereas the transplants treated with subperiosteal injections in certain places showed very slight deposition of osteoid tissue.

According to these findings, subperiosteal injections of plasma on bone grafts would seem to give rise to only very slight, if any, stimulation of new osteoid tissue formation.

There is evidence to show that ordinary bone transplants cannot be replaced by grafts of boiled bone or *os purum*. Such transplants, when implanted into soft tissues, provoke new osteoid tissue formation first after a very considerable lapse of time. Along uninjured fresh bone grafts new osteoid tissue formation occurs often as early as after one week, whereas osteoid tissue round boiled bone or *os purum* transplants cannot be demonstrated earlier than after several months (WURM, ORELL). On bone transplants, the cells of which had been killed by freezing the graft in liquid air, new bone formation was observed as early as after 30 days (ENGSTRÖM and ORELL). In two experiments I investigated whether repeated injections of plasma on boiled transplants and *os purum* might provoke early new osteoid tissue formation. In *Exp. 26* repeated injections of plasma were made on a free graft of boiled bone implanted into musculature. After 4 weeks the transplant with surrounding soft tissues was removed for histological examination; no osteoid tissue could be demonstrated. In *Exp. 27* plasma was repeatedly injected on a free graft of *os purum* inserted into musculature, the transplant together with the adjacent soft tissues being removed for examination after 23 days. Neither in this instance was osteoid tissue to be found.

### Injections of Marrow Extract, etc. Directed against Fracture Ends and Transplants within Bone Milieu.

In *Exp. 28* the effect of repeated subperiosteal injections of marrow extract round fracture ends was studied. The radius diaphyses on both sides were resected to the extent of 2 to 3 mm, a broad gap thus being made. The periosteum covering the fracture ends was not curetted. Afterwards repeated injections of boiled marrow extract were made beneath the periosteum in the vicinity of the fracture on one radius but not on the other. The development of the calluses and the union of the fractures were followed in skiagrams made at certain intervals. It then emerged that the roentgenoparent calluses developed equally early, and to about the same degree, on both sides, and that osseous union occurred as rapidly on the side where marrow extract had been injected as on the other side where no injections had been made.

In *Exp. 29* fractures of both radius diaphyses were produced in the same way as in *Exp. 28*. The periosteum, however, was curetted on the fracture ends. Subsequently extract of muscular tissue with "fracture oedema" was repeatedly injected on the fracture ends on one side. Skiagraphically, the callus formation was about equally ample on both sides.

In *Exp. 30*  $1\frac{1}{2}$  cm of the radius diaphysis was resected on both sides, the resected pieces of cortical bone then being broken up into small fragments, which were inserted into the resection gaps (transplantation of "bone chips"). On the side afterwards repeated injections were made of marrow extract. In the skiagrams new bone formation was apparent about equally early and ample on both sides, and the osseous union occurred at about the same time.

Thus, despite of considerable new osteoid bone formation being provoked by repeated injections beneath uninjured periosteum and, to a still higher degree, on damaged cortical bone, attempts to stimulate callus formation by such injections in cases of fractures or transplantation into "bone milieu" were unsuccessful.

### Experiments with Coagulated Plasma.

Injections of marrow extract, plasma, etc. stimulate new bone formation, especially when made on damaged cortex, but the substances responsible for the new bone formation are rapidly absorbed, and the effect after each injection is only temporary. When plasma is boiled, it jellifies, acquiring a gelatinous consistency. If such coagulated plasma is implanted, its absorption will be comparatively slow. Provided that even such plasma stimulates new bone formation, this effect can be assumed, because of the comparatively slow absorption, to be more lasting in proportion, and there would be reason to expect a stronger stimulation than that caused by the injection of ordinary plasma.

In *Exp. 31* it was at first studied whether plasma coagulated by boiling, when applied on the diaphysis, provokes new bone formation. Through a small incision above the median surface of the tibia a raspatory was inserted, with which the periosteum covering the tibia was curetted within a fairly large area. Subsequently coagulated plasma was laid down through the incision, being placed closely against the cortical bone. X-ray examination after 17 days revealed a thin calcareous periosteal deposit. After



26 days the bone was removed for examination. In the skiagram a calcareous periosteal deposit of about the thickness of the cortex was then visible. Histologically, there was a deposit of new bone being, at the point of maximum bulk, as thick as the cortex.

In five experiments (*Exp. 32, 33, 34, 35, 36*) the radius diaphyses on both sides were cut through with a saw, producing a gap 2 mm wide. The periosteum close to the fracture ends was curetted. Round the fracture ends in the radius diaphysis on one side plasma coagulated by boiling was placed. The development of the calluses and the osseous union were afterwards followed in skiagrams made at certain intervals. Thus it was found that the development of the calluses and the osseous union in all cases proceeded with about the same speed on both sides. A stimulating influence of coagulated plasma on the callus formation and the union of fractures consequently could not be demonstrated.

In *Exp. 37* it was investigated if the substitution of osseous tissue removed from cancellous bone was furthered by filling the defect with coagulated plasma. On both sides the cancellous bone was removed by curetting from the greater trochanter and the adjacent portion of the femur metaphysis. On one side the cavity was filled with plasma coagulated by boiling. In the skiagrams, made subsequently at certain intervals, the substitution of osseous tissue appeared to be even somewhat retarded on the side where the cavity had been filled with coagulated plasma, as compared with the other side.

Thus, in fractures with coagulated plasma the same negative result was obtained as with injections of marrow extract, etc. It may perhaps be assumed that the callus formation is maximal in these fractures, and that therefore an intensification of the biological processes could not be achieved.

### Summary.

In experiments on animals it was demonstrated that repeated subperiosteal injections of blood plasma, marrow extract, marrow autolysate and extract of muscular tissue with and without "fracture oedema" provoked an, as a rule, abundant formation of new osteoid tissue on the surface of the bone. On the other hand, also in control experiments with normal saline alone new osteoid tissue formation, sometimes being ample, was noticed.

The new osteoid tissue formation resulting from repeated subperiosteal injections of blood, marrow extract, etc. is therefore, either entirely or to a very high degree, due to purely mechanical influence.

In the new periosteal tissue thus obtained in no instance a roentgenoparent calcareous desposit was to be found. Such a deposit was, however, observed when the injections were made on cortical bone previously having been damaged with a sharp raspatory. Thus, a lesion of the cortex is essential for the origination of true new bone formation. This calcareous periosteal new bone deposit could be as thick in cases only treated with normal saline as in those where marrow extract or plasma had been injected. On the other hand, calcification did not result from injections of suspensions of ground bone of or ROBISON's calcium-phosphorus solution into the osteoid tissue.

Injections round fracture ends gave a negative result. Nor was an intensification of callus formation achieved by covering the fracture ends with plasma coagulated by boiling.

### Zusammenfassung.

In tierexperimentellen Versuchen wird gezeigt, dass wiederholte Einspritzungen von Blutplasma, Markextrakt, Markantolysat und Extrakt von Muskelgewebe in das Periost mit und ohne »Fraktur-ödem« eine zumeist reichliche Wucherung von osteoidem Gewebe an der Oberfläche des Knochens hervorrufen. Doch erhielt man auch in Kontrollversuchen mit nur physiologischer NaCl-Lösung manchmal reichliche Wucherung von osteoidem Gewebe. Die bei wiederholten Einspritzungen von Blutplasma, Markextrakt usw. in das Periost auftretende osteoide Gewebsneubildung ist also ganz und gar oder doch grösstenteils durch rein mechanische Faktoren bedingt.

In der in dieser Art erzeugten periostalen Neubildung von osteoidem Gewebe trat niemals eine im Röntgenbilde sichtbare Ablagerung von Kalk hervor. Dies wurde hingegen erzielt, wenn die Einspritzungen gegen eine im voraus mit einem scharfen Raspatorium beschädigte Cortikalis vorgenommen wurden. Eine Verletzung der Cortikalis ist also für die Entstehung einer echten Knochenneubildung erforderlich. Diese kalkhaltige, periostale Knochenneubildung fiel bei Fällen, in denen nur physiologische

NaCl-Lösung gespritzt worden war, manchmal ebenso dick aus wie nach Verwendung von Markextrakt oder Plasma. Dagegen konnte durch Einspritzungen von Knochenmehl oder ROBISON'scher Kalk-Phosphorlösung in das osteoïde Gewebe keine Verkalkung erzielt werden.

Einspritzungen um Frakturenden gaben negative Resultate. Auch durch Umgeben der Frakturenden mit durch Kochen koaguliertem Plasma konnte keine Vermehrung der Kallusbildung erzielt werden.

### Résumé.

Des expériences sur les animaux montrèrent que des injections intra-périostées répétées de sérum sanguin, d'extrait médullaire, d'autolysat médullaire et d'extrait de tissu musculaire, tant avec que sans «œdème fracturaire», provoquaient une néoformation, habituellement abondante, de tissu ostéoïde à la surface de l'os. Même dans les expériences de contrôle avec simplement de la solution physiologique de NaCl on obtint une néoformation, parfois considérable, de tissu ostéoïde. Ainsi donc, cette néoformation, qui se produit après des injections réitérées de plasma sanguin, d'extrait médullaire, etc., dans le périoste, est conditionnée en tout ou en très grande partie par des facteurs purement mécaniques.

Dans les néoformations périostées de tissu ostéoïde obtenues de la sorte il n'apparut jamais de précipitations de chaux visibles sur les radiographies. En revanche des précipités de ce genre se produisaient quand on faisait les injections au contact d'une corticale qui avait au préalable été blessée par une rugine tranchante. Une lésion de la corticale est donc nécessaire à l'apparition d'une néoformation osseuse authentique. Cette néoformation osseuse périostée, contenant du calcaire, pouvait devenir aussi volumineuse dans les cas où l'on n'avait injecté que de la solution physiologique, que dans ceux où l'on avait utilisé de l'extrait de moelle ou du plasma. Par contre, on n'obtint aucune calcification par les injections de poudre d'os ou de solution calci-phosphorée de ROBISON dans le tissu ostéoïde.

Les injections autour des fragments des fractures ont donné des résultats négatifs. On n'a pas non plus obtenu d'augmentation du cal en enrobant ces fragments dans du plasma coagulé par cuisson.

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## Operative Treatment of Gallstone Ileus Without Enterotomy.

By

O. KAPEL.

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Even though the formidable lethality of gallstone ileus given by NAUNYN — no less than 92% — is no longer valid, the lethality mentioned in more recent works — up to 50% — is also likely to be excessive nowadays because some of these calculations, at any rate in part, are based on accounts of a relatively early date (BALCH, 1). Still, gallstone ileus is yet a most erratic and serious form of ileus and an equally severe complication of cholelithiasis. Its serious prognosis is chiefly due to the often most uncharacteristic course of the disease, until the private physician of the patient suddenly is faced by the fully developed clinical picture of a severe ileus — most often in elderly obese patients with circulatory disturbances.

On going through the literature, we decidedly get the impression that at an early stage of the disease the diagnosis is more difficult than in most other forms of ileus — probably on account of the often intermittent course of the symptoms. We see again and again that even the best diagnosticians in many cases do not arrive at the correct diagnosis till very late, so that often the patients are too exhausted when they are hospitalized for the sake of operative treatment.

Even though the diagnosis is difficult, it still seems to me that WAKEFIELD, VICKENS & WALTERS (2) are too categorically pessimistic in their conclusion when they say: "There is nothing characteristic about intestinal obstruction that is caused by gall-

stones"; and it is going too far when they add that "a history of chronic cholecystic disease is of no value". It is quite true that a history of cholelithiasis by no means necessarily implies that if such a patient has ileus, it must be gallstone ileus; and it is equally true that a patient may have gallstone ileus without a typical history of cholelithiasis. But a history of cholelithiasis should always mean a memento *for the clinician and for the roentgenologist*. And there can be no doubt that the past 15 years' cooperation between roentgenology and surgery has brought not inconsiderable advances diagnostically. For, even though we have to admit that often it is only *after* the operation for gallstone ileus that the concretion can be made out in the roentgenogram, nowadays it still happens again and again that the concretion is demonstrated roentgenographically before the operation. This is largely due to the circumstance that during the last 10—15 years the roentgenologist has been consulted in the diagnosis of acute abdomen to an extent as never before. So now the presence of a concretion in gallstone ileus is not infrequently demonstrated prior to the operation in an ordinary orientating roentgenogram or with a contrast medium as adjuvant (BORMAN & RIGLER, 3; BORMAN, RIGLER and NOBLE, 4; PETRÉN, 5; NÖRGAARD, 6).

But, even though the diagnosis of gallstone ileus may be said to have become more topical than before, all clinicians still acknowledge that the diagnosis is difficult. Even in the more recent reports it still is striking to see how late the patients often are submitted to surgical treatment, and how often the diagnosis first is made on autopsy (DULIN & PETERSON, 7; ADAMESTEANU & DUMITRIN, 8).

Once the diagnosis of ileus is made, a definite treatment should be instituted immediately.

In this connection I think it may be appropriate briefly to cite the following case reported by WAGNER (9), his Case 3: The patient was a woman, greatly exhausted, with pronounced ileus and fecal vomiting. Operative treatment was advised, but the patient refused to submit to it. So she was treated conservatively, and on the 5th day she evacuated per rectum a gallstone measuring  $6\frac{1}{4} \times 3 \times 2\frac{1}{2}$  cm. The patient recovered.

WANGENSTEEN (4) has been able by means of suction drainage in the small intestine to abolish the state of ileus so that concretions are passed spontaneously; yet in 1941 he advised against such expectation.

OWENS (10), employing the same procedure, succeeded in getting a gallstone, 3 cm in diameter, to pass spontaneously. Still, the condition of these patients, who often are women over 70 years of age, is so dangerous that we have to take it as a matter of course that the danger should be eliminated by operative treatment as soon as possible if the state of the patient permits any surgical measure at all.

For this purpose, practically all surgeons employed laparotomy in the midline below the umbilicus with enterotomy along the longitudinal axis of the gut — after the stone has been pushed up orally into a dilated and healthy section of the gut. Then sutures are made longitudinally or transversally in two or three layers. In the presence of ulceration, gangrene or dubious viability of the intestinal wall, this part of the gut has to be resected if the state of the patient allows it. If this is considered impracticable, resort is made to extraperitonealisation of the intestinal section, as *ad modum* BLOCH-MIKULICZ in tumor cases, with subsequent closure of the intestinal fistula. In cases where the concretions have been situated as far orally as in the duodenum (pylorus), the opening has been made here and the concretion removed. (In such cases I should prefer, if practicable, to push the stone up into the stomach and remove it through gastrotomy.)

DULIN & PETERSON (7) have suggested to crush the stone at its usual site, far distally in the ileum. But, I think, this procedure has to be looked upon as very risky — something that is suggested also by the outcome of their own cases:

a) Stone crushed in the small intestine. The patient died 24 hours after the operation.

b) Attempt to crush stone unsuccessful. Enterotomy.

c) Attempt to crush failed. Injury to the gut after removal of the stone (enterotomy) so severe that ileocecostomy was required.

d) Attempt to crush unsuccessful.

So this suggestion, which was advanced as late as in 1939, is now, I think, merely of historical interest. Indeed, HINCHEY advises against its employment.

The prevailing treatment, as mentioned, consists in enterotomy with removal of the stone, and it is so old and generally employed that HINCHEY (11) says that “newer methods of treatment complicate rather than simplify the therapeutic problem”.

Nevertheless, I venture to assert that an operative treatment with which it is possible to abolish the state of ileus without en-

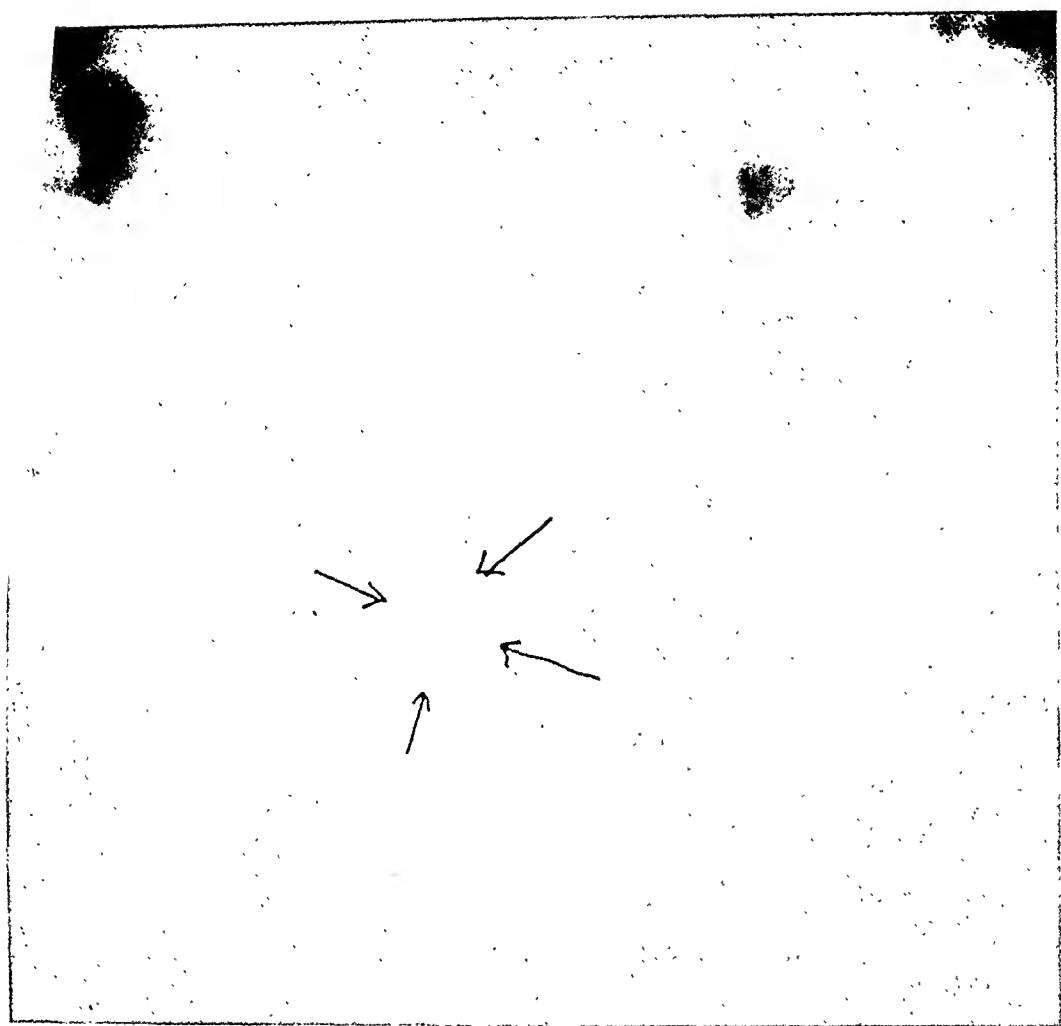


Fig. 1.

KAPEL: Operative Treatment of Gallstone Ileus Without Enterotomy.





terotomy must be said to simplify rather than complicate the therapy, as it makes the operative treatment easier, more rapid and less risky.

In two cases of gallstone ileus, the only ones I have had occasion to treat within the last 8 years, I have employed the following technique — which has worked out most satisfactorily:

The operation is performed under spinal anesthesia. Laparotomy is made in the midline, below the umbilicus. Then search for the obturating stone, which nearly always is located in the distal part of the ileum. Here we meet with a gut that is dilated above the stone and collapsed below. On gentle manipulation of the gut below the stone, also this part will dilate somewhat. Then an attempt is made *quite gently*, without exerting the least force, to mobilize the concretion, and it is found possible to make the stone slide easily towards the ileocecal junction. It may seem rather surprising, but in neither of my cases (with large cholesterol stone) did I have the least difficulty in making the stone pass the ileocecal junction. After this, I have pushed the concretion up in the ascending colon, for a short distance, and then closed the abdomen, as I think that even very large concretions in the colon will not give rise to ileus. The entire procedure has not taken five minutes. But it is essential that the small intestine is *handled with the utmost caution*; then the stone suddenly slides down — almost by itself. It goes without saying that I should not try to employ this method if the intestinal wall showed evidence of dubious viability or manifest gangrene. In both of my cases the concretion was passed by way of the rectum in a couple of days. Both patients recovered.

The case histories of these patients are briefly as follows:

*Case 1. Woman, aged 72 (Record No. 1574/41). Admitted 2/6—22/8/1941. About 2½ days before admission, sudden pain across the upper part of the abdomen, followed by vomiting, after which the pain subsided. This was repeated about 20—30 times during the following 48 hours. Jaundice. Roentgenography: Air-containing loops of small intestine, with a surface level of fluid. Diagnosis: Ileus.*

3/6: Laparotomy with propulsion of gallstone. An incarcerated gallstone is found to be firmly lodged in the small intestine as the cause of the state of ileus. The stone is cautiously pushed down into the cecum and then up in the ascending colon for some distance.

14/6: Two gallstones evacuated by the bowels.

22/8: After slight, transitory, secretion from the wound, the patient is discharged, with complete healing of the wound.

*Case 2. Woman, aged 70* (Record No. 830/43). Admitted 6/3—10/4/1943.

Four days before admission, sudden onset of severe pain in the epigastrium, radiating to the back, relieved by codein. 2 days before admission, similar pain. 4 hours before admission again a violent attack of epigastric pain, radiating to the back. No jaundice at any time. No passage of flatus or urine. *Roentgenography*: Loops of the small intestine distended with gas. In the small pelvis, an annular lime shadow of uncertain nature (Fig. 1).

7/3: Increasing state of ileus. Laparotomy with propulsion of gallstone. About 25 cm above the ileocecal junction, a gallstone is located — about the size of a Brazil nut, at any rate with one facet. The concretion is pushed down into the cecum cautiously.

11/3: On the ward round in the evening, digital removal of a gallstone from the rectum. The next stone passed during the night.

10/4: Feeling well. Discharged from the hospital.

So far, in speaking of gallstone ileus, we have considered only ileus of the small intestine. We have not tried to look into the question as to how the gallstones have entered the gut, and here this subject will merely be touched upon in passing.

I quite agree with HAND & GILMORE (12), HINCHEY (11) and BORMAN, RIGLER & NOBLE (13) in the view that even large stones in the colon give no ileus — a fact which also made WAGNER (9) conclude that in his patient the large gallstone had passed directly from the gall-bladder down into the transverse colon. Hence the above-mentioned treatment: once the stone has entered the colon it will most likely be evacuated spontaneously under suitable therapy. Undoubtedly, it was a quite superfluous measure that was taken in HOLZ' (13) case, in which the stone was found to be located in the sigmoid colon, which then was opened, and the stone removed. I fully subscribe to the procedure adopted by MARSHALL & MITCHEL (14): in one of their 3 cases the stone was found to be located in the cecum; they let it stay there, and subsequently it was evacuated naturally.

Just a few words about the treatment: If the stone is found to be faceted, the entire intestinal canal should be palpated in search for other stones. Several cases have been reported in which the patient had to submit again to laparotomy, from a few up to 14 days after the first operation, because a new stone had lodged at the site of the previous. — And if we find a single large stone left in the gall-bladder, cholecystolitotomy with cholecystostomy should be performed if the state of the patient permits this measure; if not, an operation of the gall-bladder proper should be advised when the patient has recovered after the first operation.

As mentioned, the prevailing operative treatment for gallstone ileus consists in enterotomy, extraction of the stone and suturing of the gut. Still, I think, that the procedure here suggested by me offers such great advantages that there can be no doubt that it will give a decidedly better prognosis of this dangerous form of ileus — of course, in combination with the postoperative treatment employed in every form of ileus. If, under this treatment, the stone has not been passed within 4—5 days it undoubtedly will be possible to remove it from the rectum digitally.

Even experienced surgeons in this country as well as abroad, with whom I have discussed the question, have acknowledged the advantage of this form of treatment, stating that in future they would try the method themselves. At the same time, they declared that they had never imagined this possibility, nor heard of it. This is the more peculiar as on diligent search in the literature I have found a case reported in 1888, in which the patient was treated in the same manner — also with a good result. As this case further suggests the employment of the method, I shall cite it briefly.

It was reported by CLUTTON in *The Lancet* in 1888, Vol. I, p. 123, in a discussion on gallstone ileus in the Clinical Society of London:

The patient was a woman, 72 years old. Her private physician, Dr. SIDNEY HARVEY had made the diagnosis: The probable presence of an impact gall-stone from the fact that 15 months before she had passed a large facettted biliary calculus". Laparotomy was performed. The stone could be pushed through the ileocecal valve without opening the gut, and it was passed 5 days later. It measuring  $3\frac{3}{10}$  inches in *circumference*. The patient recovered.

To me it seems that this case, together with my own two cases, speaks strongly in favor of the employment of this method in every case where the intestinal wall is not injured.

Naturally, caution has to be exercised in the manipulation of the gut so as not to produce any injury in this way. This applies in particular to cases in which the gallstones are facettted, possibly with sharp edges.

The procedure itself can be carried through within a few minutes, and it offers the unquestionable advantage that opening of the intestine is avoided in these patients who nearly always are old and obese.

### Summary.

Two cases of gallstone ileus are described in which the gallstone, instead of being removed by enterotomy, was gently milked down into the colon. Both patients recovered.

Mention is made of a similar case, reported in 1888.

### Zusammenfassung.

Beschreibung 2 Fälle von Gallensteinileus. Keine Enterotomie. Die Konkremeute wurden in den Dickdarm hinuntergeschoben.

Beide Patienten wurden geheilt. Von einem ähnlichen Fall, in 1888 erwähnt, wird berichtet.

### Résumé.

Deux cas d'iléus biliaire sont décrits dans lesquels le calcul au lieu d'être enlevé par une entérotomie, doucement est conduit dans le colon en «trayant» l'intestine.

Tous les deux malades sont guéris.

Un récit est donné d'un cas pareil, mentionné en 1888.

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From the Central Hospital of Åbo.  
(Chief: Prof. H. ELFVING, deceased.)

## On Diaphragmatic Hernia.

By

YNGVE CANDOLIN.

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Diaphragmatic hernia may not be a very common affection, but it is by no means as rare as it is often held to be, on account of the fact that an erroneous diagnosis is frequently made of this disease. This tendency is facilitated, on the one hand by the fact that the hernia is situated deep in the centre of the body, resulting in indefinite and abstruse symptoms, on the other hand by the fact that aetiology on this point varies. With the development of diagnostics follows a rise in the number of cases met with, thus, 30 cases have, for instance, been diagnosed at the Mayo Clinic during the 25-years period ranging from 1900—1925, and as many as 197 cases during the 10-years period covering the years 1925—1935 (of these, *one* surgeon, by the name of HARRINGTON, has operated as many as 105 cases); a typical example of the comprehensive material of American statistics. HEDBLOM, in 1931, collected over 1,000 cases from the world's literature, a figure which should include a considerable part of the cases observed prior to that time, in view of the fact that this malady is remarkable enough to cause even sporadic cases of it to be published. Extensive literature has been produced on this subject. The French Surgical Congress held in 1935 to which celebrities from other countries, such as HARRINGTON and TRUESDALE from the United States and SAUERBRUCH were invited, brought it up for discussion; the literature published between 1920 and 1934 on this subject exclusively, issued in the course of congressional proceedings, comprised no less than 37 pages of brevier type. A thesis on this subject was published by DUGUET in Paris, as far back as 1886. As a result of the war, a great in-

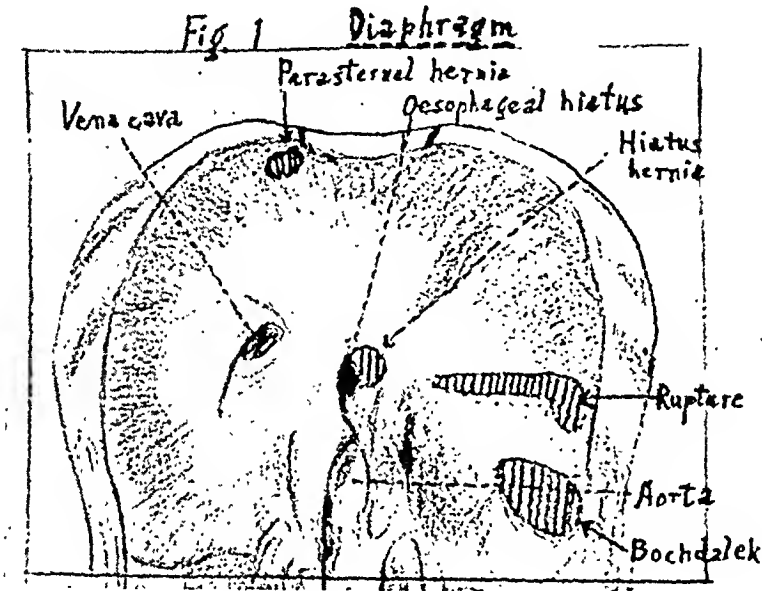
crease in the out-put of medical literature dealing with traumatic cases, may be expected. In Finland, accounts have been submitted by WALLENIUS, CEDERBERG, KOSKINEN and LANGENSKIÖLD. (About 5 cases by the last-mentioned.) To these I may now add 8 cases from the Central Hospital of Åbo, observed during the years succeeding 1934.

Diaphragmatic hernias may be assigned to several different classes. Depending on their origin they are divided into traumatic, congenital and so-called acquired hernia; the last-named constituting a rather diffuse group, to which hernias which have arisen more or less spontaneously without any real trauma being involved, are ascribed; many of the last-mentioned are, however, in all probability, of a congenital nature. Further, they are classified into genuine hernias with hernial sac and false without it. The major part of all acquired cases represent genuine hernias (according to TRUESDALE they exceed 95 %); while almost all traumatic, as well as the greater number of the congenital cases may be said to be false. — Finally hernias are divided according to their localization, a fact which is of special importance where congenital cases are concerned.

The largest group is composed of hiatus hernias through the Hiatus oesophageus. HARRINGTON came upon these during the course of his operations in 76 cases out of 105. It is to be assumed that they are relatively common at a less pronounced stage, inasmuch as they are often congenital, and that lighter cases frequently run their course without producing any more defined symptoms. The so-called acquired hernias may also as a general rule, be consigned to this type, and in many instances appear at a later stage in life through atrophy of the fatty tissues lying between the oesophagus and the encircling diaphragmatic ring; a certain pre-disposition may often be discerned; *e. g.* HARRINGTON observed in the autopsy of normal cases, that in 35 % of them a finger could be passed beside the oesophagus through the hiatus, and in 2 % even 3 fingers. Hiatus ruptures have been made the object of keen investigation by ÅKERLUND, whose classification into three categories has been generally accepted. In the first instance, the oesophagus is too short and has pulled the cardia up through the diaphragm. In the second instance the cardia is in place, but the fundus has forced its way up beside the oesophagus. In the third instance both the cardia and the adjacent region of the ventricle have pressed upwards, in spite of the

oesophagus being normal. Hiatus hernias are as a rule genuine, *i. e.* sac hernias.

An additional, though far more unusual weak spot, from a congenital point of view, is the parasternal through foramen Morgagni (by the French called foramen Larrey), in front by the base of processus xiphoideus where a. mammae perforates the diaphragm. A third lies further back in the neighbourhood of trigonum lumbocostale or foramen Bochdalek. In the last-named position the hernias frequently attain a considerable size and may hence be regarded as a stepping-stone to the vast congenital



hernias when half the diaphragm, or an extensive part of it, may be defective; in the last-named instance the hernial sac is, more often than not, missing. That is to say, that the diaphragm closes in the 4th embryonal month and if the hernia has been formed before that time, a direct connection remains between the abdomen and the pleura. It is also an extremely difficult question to decide whether hernial sac is to be found, or not, even in an autopsy; it is not easy to ascertain for a certainty whether the serous membrane in the cavity is of peritoneal or pleural origin.

Traumatic hernias are caused, either by a wound which pierces the diaphragm, and in that instance they are without sac, or by blunt or indirect violence in which case hernial sac may, or may not, be present. At perforation a hole appears which persists, or which heals with such a weak scar that the latter may give way



at any time. It is a matter of doubt, whether a diaphragmatic wound ever heals altogether; small wounds should, however, be healed, provided the omentum or other tissue has not been pressed into the wound. In the case of blunt violence the diaphragm may rupture on a large scale, most often in the cupola in the vicinity of the centrum tendineum, or at the place of attachment to the ribs.

Occasionally a secondary hernia may arise from inflammatory necrosis, succeeding trauma.

The ruptures are almost always consigned to the left half of the diaphragm; anomalies in development are more rare on the right hand side, and the liver here acts as a large tampon. At times, an intersected rupture may occur, *i. e.* the sac may penetrate through the mediastinum into the opposite side.

The size and contents of the hernias varies to a very great extent. In over 20 % the ventricle alone may be met with in the hernial sac, in 10 % the large intestine alone, then the small intestine and the spleen, more seldom the duodenum, the liver or the pancreas; all in all some 70 different combinations have been discovered (TRUESDALE).

Fœtus with large congenital hernias have small chance of surviving and generally die, either before or after birth; according to TRUESDALE only 25 % of the cases kept under observation survived the first month after birth. Strange to say, diaphragmatic hernia, otherwise, frequently does not become symptomatic before a relatively advanced age has been reached. Thus, ANDRÉ cites a patient who had passed through 7 pregnancies but contracted symptoms at the age of 44; DUVAL, again, a case that did not reveal any symptoms before the age of 66 (quoted from JENTZER).

The symptoms are rather vague: dyspeptic trouble, possibly vomiting, pains in the abdomen and in the chest, attacks resembling those encountered in angina pectoris, secondary pressure symptoms from the heart and lungs. One symptom especially underlined by LANGENSKIÖLD, is that the pains are most marked when lying down, and are mitigated when the patient stands up and the contents of the hernia sinks down or is reduced. JENTZER mentions dysphagia paradoxa as something typical: the patient is incapable of swallowing small morcels of food, but passes down large ones with relative ease. Intestinal sounds in the chest are pathognomonical, if such may, with any certainty, be localized.

Absolute conviction may be obtained by means of an x-ray examination comprising the ventricle, and in negative cases the large intestine must also be examined with contrast matter in various positions. In doing so care should be exercised to avoid confusion of a hernia with *Relaxatio diaphragmatica*, where the diaphragm is abnormally flaccid and curves in a marked manner into the thorax, but when no defect is present. (In a case of relaxation, genuine hernia may, however be met with. KUBANYI.)

Nevertheless, hernia frequently takes its course in a more or less latent manner, until a sudden attack of occlusion calls attention to the disease. Chronic incarceration may also occur; several times erosions have been observed in the mucous membrane of the ventricle, due to strangulation in the hernia-aperture, in some cases a typical ulcer has resulted from it. Such examples are mentioned for example by MATTHEWS (2 cases, one of which succumbed to haemorrhage) and by DE VITT STETTEN; even rupture of a similar ulcer has been noticed (JENSEN). It often occurs that a patient undergoes operation due to false diagnosis without the real cause of his trouble ever being unveiled (out of HARRINGTON's 105 cases, no less than 19 times). Diagnoses frequently erred upon are represented by: heart diseases, gallstone, chronic gastritis or enteritis, neurosis, whooping-cough, etc.

The only means of curing diaphragmatic hernia is by an operation. Incarceration is a force of vital indication; with symptoms of a lingering disease the high rate of mortality at these operations should be borne in mind. Opinions as to the most suitable method of operation are extremely divergent. The technical obstacles are reduced by using the thoracic approach. Cases without hernial sac and also with contents broadly adherent, are probably frequently impossible to manage any other way. In this process the pleural cavity is opened between the ribs, or with a resection of the ribs, preferably by the aid of high-pressure narcosis; LANGENSKIÖLD uses an ordinary vacuum-cleaner, with which he, after operating, sucks the air from the pleura by the aid of a soft catheter. TRUESDALE makes a lapel incision with the base upwards, including all layers of the thoracic wall. Amongst the advocates of the thoracic operation may be mentioned, SAUERBRUCH, HESSE, LANDOIS, LANGENSKIÖLD. Hiatus hernias are particularly held to be most easy of access in this manner. The abdominal way of approach through an incision paramedially or under the rib arch is recommended for instance by HARRINGTON

and KÜTTNER. HARRINGTON maintains that he has succeeded with abdominal incisions in all his operations, even though the intestines have been adhesive high up in the chest, a statement which seems wellnigh incredible. Even such an expert technician as SAUERBRUCH, always uses the thoracic means of access. Pneumothorax can not be avoided, however, by an abdominal incision, if the pleura communicates directly with the abdomen via the diaphragmatic aperture, as in most cases of congenital hernias. Parasternal hernias are easiest to approach by way of the abdomen. A combined operation consisting of an abdominal incision which is continued inter-costally through the rib curve and which may be effected without opening the pleura, has been developed, particularly by French surgeons.

If the hernia has been reduced the entrance to the diaphragm is closed after freshening of the rim has taken place. This may be impossible in the case of widespread defects, or succeed solely by suturing the diaphragm onto the wall of the thorax, through thoracoplasty of the lower ribs or by means of a free transplantation of the fascia lata over the defect. A valuable aid is afforded at more demanding operations, by the use of a temporary phrenicotomy, which consists in exposing n. phrenicus at the neck, compressing it, intersecting it, or freezing it with ethyl chloride, or paralyzing it with a novocain injection; in an operation the thoracic way thus may also be effected at the place where the nerve enters the diaphragm. In consequence the diaphragm relaxes and may be drawn down-wards, thus affording easier suturing. In cases which are inoperable on account of the patient's high age or bad general state of health, a palliative phrenicotomy may neutralize any contraction of the hernia and thus alleviate the trouble; it may even relieve an incarceration.

The mortality rate in connection with the operation of diaphragmatic hernia is considerable. The statistics compiled by HEDBLÖM according to which 32 % of the cases have succumbed, on the average, 22 % of them forming simple hernia, 54 % obstructed hernia, may here be cited as an example. The best prognosis is afforded here by the thoracic operation.

Examined in the light of comparative evidence for various methods of operation these figures may, however, be held to be misleading. A closer inspection proves that both in thoracic and combined operations mortality for simple cases is higher than that of incarcerated, which is absurd and must be due to the fact that

bad and fairly bad simple hernias have been operated according to these methods, but only light, incarcerated cases, i. e. *that the bad incarcerated ones have been operated from the abdominal line of approach and consequently unduly encumber the prognosis for laparotomy.*

*Mortality according to Hedblom.*

	Total Sum			Simple			Incarcerated		
	Cases	Deaths	%	Cases	Deaths	%	Cases	Deaths	%
Laparotomy .	246	96 = 30 %		146	27 = 19 %		100	69 = 69 %	
Thoracal op. .	133	26 = 20 %		109	22 = 20 %		23	4 = 17 %	
Combined op. .	89	28 = 31 %		63	21 = 33 %		26	7 = 27 %	
Total	467	150 = 32 %		318	70 = 22 %		149	80 = 54 %	

Skilled surgeons may, however, keep the rate of mortality surprisingly low, as for instance SAUERBRUCH in his thoracic operations, with 6 % mortality of 83 operated cases, and HARRINGTON in laparotomy with 7 % of 97.

If the patient survives the operation a good result is ensured; HARRINGTON only met with 2 relapses in his 105 operations.

The eight cases observed at the Central Hospital of Åbo (including the military department) represent almost all types of hernia.

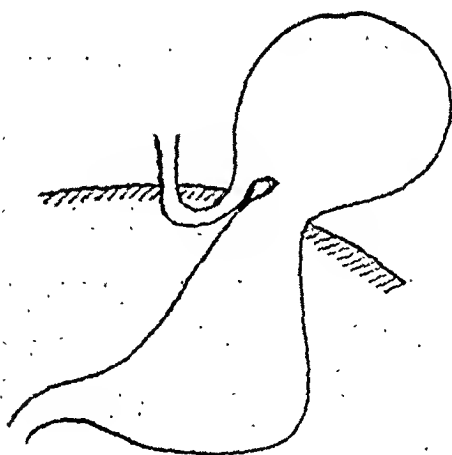
Four of these cases are traumatic following a perforating wound, one is incarcerated.

1) 42 years of age. Male. In the Army. Hit by shellsplinter 9. 3. 1941 on left side of chest. At laparotomy abdominal organs appeared to be intact. Furloughed home on account of being over age. On 18. 6. 1943 he suddenly began to suffer from serious abdominal pains and ventral splashing. As the connection with the wound could not be clearly determined he was taken into a hospital for civilians. Operated 21. 6. 1943 (BALTSCHIEFFSKY) for adhesive occlusion, with Marwedels incision below the left rib curve. Flexura lienalis and omentum had made their way into the pleural cavity through a relatively insignificant opening in the diaphragm. After reduction the opening in the diaphragm was closed and 5. 7. 1943 the patient could be discharged as convalescent.

2) Aged 22. Male. Army-man. Severely wounded by shellsplinter 20. 7. 1944. Humeral fracture and left-sided haemothorax which developed into empyema and was operated on 16. 8. 1944 by thorac-

ostomy. In the early part of 1945, while he was yet in hospital, he began to complain of abdominal pains after meal-time, and vomiting. A roentgenogram revealed that the oral part of the ventricle was to be found in the left postero-inferior section of the thoracic cavity; the contrasting matter had risen up to the higher part of the oesophagus and scarcely emptied itself at all. At the operation, performed on the 7. 2. 1945 with a Marwedel incision under the left rib curve (BALTSCHIEFSKY), a 3-finger-wide opening could be ascertained to the left, through which the fundus-half of the ventricle together with the cardia had been forced up into the chest. The oesophagus passed down through the diaphragm in the normal manner, but then turned back through the rupture to the cardia. After reduction the rupture was closed and the patient was 11. 3. 1945 discharged as convalescent.

Fig. 2. (Case 2.)



3) Aged 21. Male. Ex-service man. Hit by shell-splinter 8. 8. 1944. Received a wound the size of the nail of the little finger, in the VI rib to the left, causing a slight subcutaneous emphysema, as well as a haemothorax which developed into an empyema. Neither the splinter nor the mark of exit could then, or at any time later, be discovered. Rib resection 4. 9. 1944. In hospital until 22. 7. 1945. Shortly after leaving hospital he began to feel abdominal pains following close upon meals. Sent to civilian hospital. Under observation for ulcer. Admitted to our hospital 22. 11. 1945. An x-ray picture revealed the diaphragm reaching considerably higher than usual and that a large part of the central region of the ventricle had passed up through a wide opening in it. Operated 29. 11. (BALTSCHIEFSKY) with a Marwedel laparotomy



Fig. 3. Case 3.



Fig. 4. Case 3.

CANDOLIN: On Diaphragmatic Hernia.



Fig. 5. Case 5.



Fig. 6. Case 5.

incision. The major portion of the ventricle, a part of colon transversum and some coils of the small intestine were deposited in the hernia. The hernia entrance occupied the centre of the left half of the diaphragm and was permeable for over a hand's breadth, the oesophagus lay at the rim of the aperture. The hernial sac<sup>1</sup> was the size of a child's head, smooth serous membrane continuously encountered, no signs of scars. These circumstances indicate the possibility of a congenital hernia, the fact of the patient's being wounded in the same region constituting but a coincidence. The rupture was easily reduced but the closing of the opening met with great difficulties. The patient was discharged as convalescent 21. 12. 1945. A follow-up examination in February 1946 showed him to be completely recovered.

4) 28 years old, Male. In the Services. Wounded 2. 2. 1940 by a bullet which pierced the left side of the breast. Remained in hospital for 10 months and re-entered military service, only in 1943. Already half-a-year after sustained injury he began to complain of abdominal trouble and some time later hyperchlorhydria could be ascertained. In July 1944 the pains increased; 2. 8. 1944 he was taken to hospital for gastric ulcer with high acid values ( $\text{HCl} = 67$ ,  $\text{TA} = 93$ ). X-ray examination, tonus and peristaltic of ventricle were normal; no remains; bulbus duodeni deformed. To the left a diaphragmatic hernia; a sizable share of the small intestine had forced its way up into the thoracic cavity; in the left infero-lateral section moderate pneumothorax. — Contrast enema was not given, consequently the possibility of the colon having partaken in the formation of the contents of the hernia-sac cannot be excluded (the small intestine is scarcely ever to be found there alone). The patient was not keen on undergoing an operation and was then pronounced fit for auxiliary service 29. 9. 1944. — The magnitude of the hernia in comparison with the small scars is remarkable, and in this case one might also consider the possibility of the trauma being an occasional coincidence, that the hernia was congenital and had developed without exhibiting any more marked symptoms, and that the trouble was principally due to the duodenal ulcer.

The fifth case<sup>2</sup> was a traumatic rupture caused by blunt force.

5) Aged 32. Male. Badly jammed during work 27. 5. 1938, abdominal contusion, extensive lumbogluteal haematoma, which developed into necrosis of skin which was cured after 7 months when several epidermal transplantations had been made. Nine (9) months succeeding trauma he started to complain of nausea, vomiting, and pains to the left of the hypogastric region, while a softened tone was revealed in the inferior section of the left lung. X-rayed 27. 1. 1939. Diaphragm a full hand's breadth higher to the left than to the right and almost immovable; the fundus of the stomach above the diaphragm; fundus and part of corpus compressed to a width of 3 cm. Operation 17. 2. 1939 (ELFVING), the thoracic way of approach, involving resection of 2 ribs. The ventricle was pressed up through a  $1\frac{1}{2}$  hand's breadth sized gap in the diaphragm and was adhering to both pleura and diaphragm;



after release and reduction the opening was sutured. Increasing difficulty in respiration followed upon operation, with exitus 19. 2. 1939.

The sixth case was incarcerated and rather uncertain as to type, it may be congenital or acquired, possibly a hiatus hernia.

6) 29 years old. Male. For a long time he had felt burnings (acidity) in upper part of abdomen and had not been able to take any acid food when he suddenly on 30. 6. 1934 was seized with grave abdominal pains which, however, decreased the following day. First diagnosed for pleurisy, but when the pains increased and an obstruction-like condition developed, he was taken to hospital and *operated* 4. 7. 1934 (BALTSCHIEFFSKY): Median incision elongated by a transversal left-sided incision. Part of the wall of flexura lienalis was squeezed into an opening in the centrum tendineum and a portion of the intestinal wall, the size of the palm of a hand, had been turned into necrosis. Following reduction and suturing of the opening, the bowel was led out through the incision in the abdominal wall. Nevertheless the patient died 7. 7. 1934, from peritonitis and intestinal paralysis.

The last two cases consist of congenital hernia, both incarcerated.

7) Aged 45. Male. Earlier in good state of health. Suddenly 24. 6. 1942 stricken with heavy pains under the chest; they gradually decreased, but increased a few days later when the patient became subject to vomiting. Taken to hospital 29. 6., but passed away the following day. At the *autopsy*, a 10 cm wide hernial aperture was observed to the left of the aorta; the whole left half of the thorax up to the clavicle was filled with ventricle, small intestine and omentum, while the lung was compressed to a string at the mediastinum.

The eighth case is the most remarkable and the impulse to this paper.

8) 23 years of age. Female. Enjoyed good health. No more remarkable trauma in anamnesis. Routine x-ray examination of lungs at the Pemar Sanatorium 10 and 5 years ago, on which occasion the left lung was stated to be atrophied (no picture taken). She suffered five years ago from an attack of abdominal pains which lasted a day and a half. — *Pregnant VI month* (1st pregnancy), when she was suddenly taken with bad abdominal pains and vomiting. Following day taken to gynaecological department of the hospital. The abdomen was abnormally large and tense, the patients gravid uterus dominated the abdominal deposit while to the left of it an indefinite resistance was met with, which might possibly be a twisted ovarian cyst. At *laparotomy* with a long median incision (at first under the navel) the uterus was found to correspond to an ordinary 6 months gravidity, while the adnexa were completely normal. As the case evidently lay outside the pale of gynaecology a surgeon (*i. e.* the undersigned) was called in. The

abdominal cavity at first sight presented a rather striking appearance. Except for the uterus and the adnexa the peritoneal cavity was almost void. The whole of the right-hand side of the belly revealed a blank peritoneal surface. The liver was however in place, the strongly dilated fundus ventriculi appeared with a considerably swollen spleen on its convexity; but then the ventricle suddenly bent backwards and upwards and vanished. To the left lay a small coil of sigma, from there the narrow colon transversum passed upwards like a band and disappeared. There was no sign of the rest of the intestines. The diagnosis was thus settled. To the left in the diaphragm an opening could be felt the size of a fist and which ended laterally with a thick, sharp edge which had to be cut through before the contents of hernial sac could be reduced. The pylorus half of the ventricle, very dilated, the whole of the coecum with appendix, together with the pancreas and retroperitoneal fatty tissues, were drawn down from the pleural cavity, all imbibed with a gelatinous fluid and easily moved, the small intestine in its entirety, coecum with appendix and colon ascendens plus transversum and omentum. The whole cavity was walled in with a smooth serous membrane without adherences and stretched as far as cupula pleurae, while the lung felt like a half-solid node at the mediastinum. The opening in the diaphragm was closed with silk sutures, which presented no difficulties as the intestines were taken out of abdomen. To find room for the intestinal canal in the abdominal cavity proved on the other hand, to be impossible, so a *sectio caesarea minor* was effected, as the patient anyhow with certainty would abort, if she survived the incision. Further, a *gastrostomy* was applied to diminish the volume of the ventricle, upon which a great quantity of matter resembling coffee-grounds discharged itself. The exact closure of the abdominal wound was then realized without any greater difficulty. However, as expected the operation weakened the strength of the patient to such an extent that she died 31. 7, i. e. 3 days after operation.

This was, accordingly, a congenital hernia with a large aperture to the left in the diaphragm. An incarceration which was impending a few years before had receded, but now the pressure of the gravid uterus became too strong and a new obstruction became apparent. It was remarkable that the retroperitoneal tissue with the pancreas and duodenum was so loose that they were all able to slide up into the chest. From a technical point of view it was surprising that the closing of the defect could be so easily accomplished. The hernia was a so-called false hernia with serous membrane common to both cavities. It would have been of interest to examine the conditions in the thorax more closely, but owing to the fact that the relatives removed the body before an autopsy could take place, this was impossible.

Thus of the above 8 cases, 2 were congenital, 1 congenital or acquired, and 5 traumatic, 4 as a result of bullet or shell shrapnel, and one caused by blunt violence; all situated on the left side. It may be difficult to decide what type a certain hernia belongs to. In two of the cases mentioned in this paper which I have assigned to the traumatic class, the hernia was extensive enough to place it with the congenital type, as the rupture opening resulting from bullet wounds is generally of small dimensions; it would indeed be a very singular coincidence that they should both happen to be wounded at this spot at a suitable time before the appearance of the symptoms. 4 hernias were incarcerated. The time that elapsed between the trauma and the operation including the making of a diagnosis, varied from between  $\frac{1}{2}$  and  $4\frac{1}{2}$  years. The findings and results of the operations may be seen in the following table.

			Contents	
4 perforating traumas	1 op.	conval.	colon (wall of flexura lienalis)	incarcer.
	1 op.	conval.	ventricule (+ cardia)	
	1 op.	conval.	ventricule + small intestine and colon	
	1 not op.	untreated	small intestine (+ colon?)	
1 blunt trauma . . .	1 op.	died	ventricule	
1 hiatus hernia . . .	1 op.	died	colon transversum	incarcer.
2 congenital hernia .	1 autopsy	died	ventricule + small intestine	incarcer.
	1 op.	died	almost entire intestinal canal	incarcer.

Operation performed by laparotomy in all cases except no 5 (blunt trauma) which was operated by the thoracic way of approach.

*An undiagnosed or untreated diaphragmatic hernia constitutes a grave danger to the patient. The duty of the surgeon in doubtful cases is to make a careful examination and when a diagnosis has been formed to endeavour to perform the operation during a calm interval; with weak patients a palliative phrenicotomy should be considered. The*

*choice of operative method of approach depends upon the type of case in question, as well as the technical means e. g. of high pressure narcosis; if the hernia is not adhesive the abdominal way appears to be practicable. The shape of the rib curves also plays an important part in the choice, a narrow epigastric angle is unfavourable, a wide one facilitates the approach. If a diaphragmatic rupture or defect has been discovered e. g. at laparotomy of a bullet wound, it is advisable to close the hole simultaneously, as the chances of a future hernia are very great. — The roentgenologist should examine the ventricle with contrast matter in various positions. In negative cases an examination of the large intestine always should be added, otherwise the hernia may be overlooked; in one of the cases here described, for instance, only the ventricle could be observed, although part of colon transversum was also involved. — To general practitioners applies, that in cases exhibiting vague symptoms in the region of the diaphragm, the possibility of a diaphragmatic hernia should be taken into consideration, especially if the trouble is mitigated in an upright position, while the patient should be sent to a hospital in possession of the resources necessary for an adequate examination.*

### Summary.

8 cases of diaphragmatic hernia have been observed at the Central Hospital of Åbo, since 1934. 4 were the result of perforating trauma, 1 of blunt trauma, 1 was a hiatus hernia and 2 cases were congenital. 4 cases were incarcerated. In one of the last-mentioned instances incarceration arose in connexion with a VI months' pregnancy; the hernial sac filled the whole of the left part of the thorax and contained half the ventricle, the whole of the small intestine, the major portion of the large intestine as well as the pancreas. — 5 were operated by the abdominal way (2 died), 1 the thoracic way (died); 2 were not operated upon (1 died from incarceration). All survivals belong to the bullet or shellsplinter-class. The writer is of the opinion that operation per laparotomy from a technical point of view can be less difficult than one might imagine. It is no easy task to diagnose this ailment, which demands confirmation by an x-ray examination with contrast matter. When the diagnosis has been ascertained, it is advisable to perform an operation provided the health of the patient permits, and that should preferably be undertaken during an interval devoid of symptoms.

### Zusammenfassung.

Der Verf. veröffentlicht 8 Fälle von Diaphragmahernie, beobachtet im Zentralkrankenhaus der Stadt Åbo seit 1934. 4 Fälle entstanden durch perforierende Gewalt, 1 durch stumpfe Gewalt, 1 war ein Hiatusbruch und 2 waren kongenitale Brüche. 4 Fälle waren inkarzeriert. Bei einem der kongenitalen Fälle entstand eine Inkarzeration im Anschluss an eine Gravidität im VI. Monat. Der Bruchsack füllte den ganzen linken Teil des Thorax aus und enthielt die Hälfte des Ventrikels, den ganzen Dünndarm, den grössten Teil des Dickdarms und das Pankreas. Durch Laparotomie wurden 5 operiert (2 gestorben), durch Thorakalschnitt 1 (gestorben), 2 wurden nicht operiert (1 gestorben an Einklemmung). Alle Überlebenden gehören zur Gruppe der Splitter- bzw. Schusswunden. — Der Verf. weist darauf hin, dass eine Operation per Laparotomie technisch leichter sein kann, als man glauben würde. Die Diagnose ist schwierig und fordert Bestätigung durch Röntgenuntersuchung mit Kontrastmittel. Ist die Diagnose gestellt worden, soll man operieren, falls der Zustand des Patienten es nur erlaubt und zwar am liebsten während einer symptomfreien Zwischenperiode.

### Résumé.

L'auteur rapporte les observations de 8 hernies diaphragmatiques traitées à l'Hôpital Provincial de la ville d'Åbo, en 1934. Quatre étaient dues à une lésion perforante, une à un traumatisme contondant, une s'était produite au niveau du hiatus, et deux étaient congénitales. Quatre d'entre elles étaient étranglées. Dans un des derniers cas l'étranglement se montra en relation avec une grossesse du sixième mois. Le sac herniaire remplissait complètement l'hémithorax gauche et contenait la moitié de l'estomac, tout l'intestin grêle, presque tout le gros intestin, ainsi que le pancréas. Cinq des sujets furent opérés par laparotomie (2 morts), et un par voie thoracique (mort); chez deux il n'y eut pas d'intervention (une mort, par incarceration). Tous les survivants appartiennent au groupe des blessés par éclats d'obus ou par balle. L'auteur constate que l'opération par laparotomie peut être moins difficile, du point de vue technique, qu'on ne le croyait. Le diagnostic est fort difficile et demande à être contrôlé par radioscopie,

avec ingestion de baryte. Le diagnostic établi l'opération s'impose, pour peu que l'état du patient la rende possible, et elle s'exécutera «à froid» de préférence.

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## On Shock during the Healing Stage of Peritonitis.

By

PHILIP SANDBLOM and BIRGER HAHN.

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Owing to the increasingly rationalized methods of therapy the mortality following peritonitis has during the last decade been substantially reduced. Severe cases of peritonitis which earlier were fatal during the first stage of the disease may now in many instances be brought through the critical period and to healing. Due to this, we have been given occasion to deal with later stages of the disease which previously were little, if at all, known. To take an example, the increasing frequency of mechanical ileus in the later course may be mentioned (MULHOLLAND).

For a detailed description the reader is referred to the excellent monography on peritonitis by STEINBERG (1944). The object of the present communication is to illuminate a condition of shock which occasionally appears during the healing stage of peritonitis (and which as far as we have been able to ascertain has not previously been described).

The morbid picture of peritonitis includes as major features, dependent on each other, the factors of infection, intoxication, shock, and so-called paralytic ileus. A rational therapy is directed towards all of these factors. The paralytic ileus may be considered to be that which presents the greatest difficulties. It is caused by the involvement of the bowel by infection, intoxication, and thereby conditioned disturbances of abdominal circulation. All measures directed towards these factors also contribute towards the relief of the ileus condition.

Direct therapeutical measures against meteorism are drainage of the intestinal canal by inlaying tubes, preferably Miller-Abbott's tube, combined with drainage according to Wangensteen's method. To these measures is added inhalation of oxygen in a strong concentration. In severe cases, and in cases where this treatment for various reasons is difficult to carry out, however, the ileus condition with a large meteoristic and distended abdomen may remain for several days and even longer. Treatment is nowadays often even in these cases recompensed by a gradual improvement of the patients' condition in spite of the ileus, revealed by a falling temperature, improved circulation and decreasing intoxication. Finally, the bowel resumes activity as a sign of the healing of the local processes: gases and subsequently stools are passed and the meteorism abates. (This stage is not to be mistaken for that in which with a progressing deterioration and continued ileus the passage of some foul, liquid motions merely implies that the intestinal canal is running over.)

Thus, the bowel resumes its activity more or less rapidly — as a rule gradually and parallel with other signs of improvement, but sometimes more suddenly. We have observed that those cases in which the bowel speedily resumes function after having been inactive for some time have a tendency to fall into a condition of shock, which, if worst comes to worst, may kill the patient.

The shock in these cases apparently not being associated with other changes of the patient's condition, we consider that it in all probability is due to the returning functional activity of the bowel. Naturally, one should be cautious in definitely establishing such a connection: these patients are in a latent state of shock, which for trivial reasons may change into a frank condition thereof. However, the course described has been of too regular an occurrence merely to be a coincidence, and also seems, as far as we have ascertained, to be the experience of other clinics.

When therefore we in the treatment of a severe peritonitis with protracted meteorism hear that the bowel has moved and that the abdomen has begun to subside, we do not exclusively consider this as a satisfactory sign of recovery, but also as a warning signal.

A recent case illustrates the facts mentioned above so pertinently that we desire to present it in detail.



### Case Report.

A girl, one-and-one-half years of age (KLV 68/46) was hospitalized after one week of illness with rhinitis and a cough, but with absence of abdominal symptoms. During the last twenty-four hours the general condition had become deteriorated, with a temperature of  $40^{\circ}$ , and a couple of loose mucous stools. On admission the abdomen was soft but revealed a slight diffuse tenderness. The patient was admitted to the Medical Clinic, with the suspicion of bronchopneumonia. The picture of a peritonitis, however, now developed insidiously, at first variably with slight meteorism, muscular tension and shock, subsequently with pronounced and definite symptoms. The patient was after four days transferred to the Surgical Clinic and operation carried out. A gangrenous perforated appendix in an abscess which was not clearly demarcated was found medially amongst the small intestines. Thin pus, containing hemolytic *B. coli* was in addition found spread diffusely in the abdomen. The appendix was removed and the abdomen closed without drain. During the further course the patient was treated with constant drainage of the intestinal canal by tubes per rectum and orally, the latter being connected with a suction apparatus. Controlled administration of fluid and plasma, sulfa- and penicillin therapy and oxygen in high concentration were instituted.

The patient's condition, however, was poor with a state of shock and the abdomen markedly dilated and distended. The abscess was drained on the second day following operation.

Improvement of condition on the third day with falling temperature and less shock. The abdomen was less distended, but still tense.

On the fourth day continued improvement. The condition of shock was raised, sensorium clearer. The abdominal girth also began to subside; gases were passed, and in the afternoon, several small offensive stools. A manifest diffuse oedema began to develop in spite of normal blood values for albumen and electrolytes.

During the following night a shock suddenly ensued, coincidentally with an increase of the oedema. In spite of intense shock therapy death occurred on the following day.

Necropsy revealed a generalized fibrinopurulent peritonitis with loose adhesions of the small intestines.

Atelectatic areas of the lungs. Moderate fatty degeneration and necrobiosis of the liver and kidneys.

*Epicrisis:* The course of the patient's disease may be reconstructed with fairly great accuracy. The patient was probably first taken ill with appendicitis, medially amongst the small intestines, on perforation giving rise to an abscess. This abscess was not clearly demarcated and owing to its localization, occasional suppurations occurred into the free abdominal cavity. The central localization of the abscess explains the absence of abdom-

inal symptoms and of abdominal pain. The fact that only small amounts of leakage occurred at a time explains the variable course with repeated conditions of shock and but occasional symptoms of peritonitis.

Some days following operation the peritonitis apparently was well on the way towards healing and on the fourth day the condition was so much improved that there seemed to be good hopes of recovery. Already at this stage, however, we expressed apprehensions for the period when bowels and abdominal circulation would resume normal function, fearing that a rapid resorption of the large amount of toxins in the abdomen might bring on the danger of toxemia and shock.

Our misgivings were confirmed when a pronounced shock of the histamine type appeared, uncontrollable and leading to death.

The development described is similar to the dangerous condition of shock occasionally appearing in association with the relief of a mechanical ileus, perhaps most pronounced in intussusceptions of long standing. AIRD has bestowed special attention to this question. He has also studied this depressor effect experimentally by inflating an excluded intestinal loop with air, subsequently opening the exclusion suddenly. The effect was also obtained in animals in which the bowel was denervated, and is by AIRD explained to be brought about by an acute toxemia.

In a paralytic ileus during peritonitis the recovery will hardly be as sudden as in the relief of a mechanical ileus, but on the other hand we have the complication of bacterial toxins, from the peritonitis added to the intestinal toxins. Furthermore, the latent shock present more easily becomes manifest in this condition.

In the treatment of peritonitis attention ought to be directed towards the contingency of a late shock in the stage of healing. Of major importance is the institution of an efficacious drainage of the digestive canal, preferably with Miller-Abbotts' tube and suction according to WANGENSTEEN, particularly in cases where meteorism and suspension of passage are not speedily relieved. In these cases it might possibly be advisable to replace a portion of the intestinal contents obtained through the Miller-Abbotts' tube with a suspension of animal coal in order to bind the toxins.

### Summary.

Attention is drawn to a stage of shock which may occur during the healing stage of a peritonitis when intestinal function sud-

denly is resumed after having been suspended for a period of some duration. The course is illustrated by a typical case. A comparison is drawn with instances of shock occasionally ensuing on the sudden relief of mechanical ileus. In the treatment stress is laid on the importance of an efficacious drainage of the intestinal canal through inlaying tubes.

### Zusammenfassung.

Es wird auf ein Schockstadium aufmerksam gemacht, das während der Heilung einer Peritonitis eintreten kann, wenn die Darmfunktion plötzlich wieder in Gang kommt, nachdem sie eine Zeitlang ausgeschaltet war. Der Vorgang wird durch einen typischen Fall veranschaulicht. Vergleiche werden angestellt mit Schockzuständen, die hin und wieder einmal auf die plötzliche Behebung eines mechanischen Ileus folgen. Bei der Behandlung wird Gewicht gelegt auf die Bedeutung einer effektiven Drainage des Darmkanals durch eingelegte Röhren.

### Résumé.

L'attention est attirée sur un état de shock qui peut survenir pendant la convalescence d'une péritonite quand la fonction de l'intestin reprend tout à coup après avoir été inhibée pendant une période d'une certaine durée. L'évolution des accidents est illustrée par un cas typique. Une comparaison est faite avec des exemples de shock se produisant occasionnellement après la suppression brusque d'un iléus mécanique. Pour le traitement, on insiste sur l'importance d'un drainage efficace du conduit intestinal par des tubes laissés à demeure.

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## The Problem of Hypoproteinemia in Delayed Gastric Emptying after Stomach Resection.

By

LEIF EFSKIND, M. D.

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### Introduction.

Recent investigations on the serum proteins in patients with surgical affections in the gastro-intestinal tract have brought up the question as to their possible rôle in the postoperative passage difficulties which sometimes arise in these patients after anastomosing operations. The theoretical arguments that hypoproteinemic edema in the gastro-intestinal walls could obstruct passage through the site of the anastomosis as well as cause a reduction in peristalsis thus giving rise to difficulties in evacuation are not unacceptable. However, the clinical and experimental data presented in the literature as a basis for this assumption are not very convincing. MECRAY, BARDEN and RAVDIN (1937) found prolonged evacuation time in both intact and operated stomachs in dogs which they assumed had hypoproteinemia. However, their control of the serum proteins was not beyond reproach, nor was their clinical material convincing. BARDEN, RAVDIN and FRAZIER (1937) found prolonged evacuation time in patients with stomach resections after Billroth I and II when there was hypoproteinemia. They believed that this was due neither to reduced tonus or peristalsis, but to edema at the site of anastomosis. BARDEN, THOMPSON, RAVDIN and FRANK (1938) found that in dogs with experimental hypoproteinemia, due either to diet or plasmapheresis, there was considerable prolongation of the time required for a contrast meal to pass through the small intestine. They

ascribed this to edema in the intestinal wall. CASTEN and BODENHEIMER (1941) have demonstrated edematous intestinal loops and edema in the G—E opening which they believed due to hypoproteinemia on relaparotomy of a patient with passage obstructions. However, they had not made any protein determinations in this patient.

The evaluation of a possible causal relationship between postoperative passage obstruction and visceral edema would be difficult in a clinical material. The demonstration of such edema is not possible as these patients are rarely relaparotomized. There are therefore only indirect indications of visceral edema, namely firstly the demonstration of a hypoproteinemia so extreme that the colloid osmotic pressure lies below the critical concentration for the occurrence of edema. Secondly the demonstration of external edemata which would indicate that there may also be edemata in the intestines with their low tissue tension. Thirdly there are certain indications *ex juvantibus* in retention patients who are edema suspect.

The significance of the hematological findings is considerably diminished by the fact that experience has shown that postoperative passage difficulties occur in many patients who show no indications of hypoproteinemia and, on the other hand, as shown by the present material, many patients with pronounced hypoproteinemia have an uncomplicated postoperative progress. The demonstration of external edemata is probably the most reliable indication that visceral edemata are also present, on condition that they are due to hypoproteinemia. As regards conclusions *ex juvantibus*, the effect on retention of the restoration of the protein values, we know that a postoperative retention can disappear spontaneously and rather quickly without any changes in the serum protein values. The immediate disappearance of the retention after the administration of adequate amounts of proteins is therefore no decisive proof either.

It thus appears that none of these criteria alone affords sufficient evidence to allow the conclusion that visceral edema has been present. However, on consideration of all of them the probability of such a conclusion is increased. In the present material of patients who have undergone gastric operations, those who have had retention complications will be examined with regard to their serum proteins and external edemata as well as the observed effect of the protein therapy administered.

### Material.

The controlled total material consists of 312 patients who have undergone stomach resection after MOYNIHAN. The majority of them were operated under spinal anaesthesia. In 28 of these 200 cc or more could be aspirated from the stomach after the 5th postoperative day, without any peritoneal reaction or other external cause which might give rise to dynamic ileus. As seen in Tables I and II these retention patients are distributed almost equally between the three groups of diseases. In 4 of them there was mechanical ileus and the patients were re-operated. They are therefore excluded from this material. The hematological findings for the other patients are presented in Table III.

Table I.

*The Material of Gastric Resections.*

Patients operated for gastric ulcer . . . . .	122.
"          "          " duodenal " . . . . .	110.
"          "          " gastric carcinoma . . . . .	80.

Table II.

*The Material of Delayed Gastric Emptying after Resection.*

Patients operated for gastric ulcer . . . . .	9.
"          "          " duodenal " . . . . .	9.
"          "          " gastric carcinoma . . . . .	6.

### Patients Operated for Ulcus Ventriculi.

This group consists of 9 patients. The pre-operative protein values were, on the average, about the same as in the patients without edema. In one of these (No. 9) the total value is low but with a very high albumin content so that the oncotic pressure is relatively high and lies considerably over the limit which is critical for edema genesis. There was no evidence in the case history for chronic hypoproteinemia. The minimum postoperative total values are under the edema limit in 2 patients (Nos. 2 and 6). However, the same holds true for these as for No. 9, namely that the albumin fraction is so high that the oncotic pressure will be correspondingly high and therefore there should be no danger of edema. None of these exhibited signs of external edemata.

Table III.

No.	Age	Diag.	Operation	Complic.	Date	Tot. Prot. %	Alb. %	Glob. %	Hgb %	Red. Corp.	Hem. crit.	Cl.	Asc. Acid.
1	43	Ule. ventr.	12/3 43 Res. ventr.	÷	10/3 20/3	5.88 7.55	5.74 4.84	1.14 2.71	109 91	5.1 4.4	44 36	91 104	0.25 0.20
2	54	, ,	10/1 43 , ,	÷	0/4 20/4	6.79 5.49	5.01 4.07	1.78 1.42	121 72	5.1 3.6	49 33	99 97	0.30 0.25
3	43	, ,	5/7 43 , ,	:	3/7 8/7	7.84 6.01	5.28 5.09	2.56 0.95	91 88	4.7 4.9	36 29	99 107	0.20 0.20
4	51	, ,	10/7 43 , ,	:	2/7 20/7	7.01 6.12	5.01 4.10	2.03 2.32	86 82	4.3 4.1	37 35	103 100	
5	45	, ,	1/11 43 , ,	:	1/11 12/11	8.12 5.92	5.13 3.71	2.99 2.21	115 101	5.8 5.1	45 35	99 99	0.15 0.10
6	43	, ,	5/2 45 , ,	:	6/2 10/2	7.34 5.17	4.13 3.61	2.91 1.53	117 104	5.3 5.0	45 38	97 88	0.10 0.10
7	50	, ,	23/2 45 , ,	:	23/2 11/3	6.22 7.27	3.72 4.83	2.50 2.44	111 103	5.8 4.7	43 40	99 82	0.10 0.10
8	50	, ,	21/12 42 , ,	:	10/12 23/12	5.70 5.68	3.90 3.11	1.80 2.57	93 80	4.3 3.5	38 28	103 103	0.25 0.20
9	33	, ,	23/11 43 , ,	÷	23/11 5/12	6.38 5.87	4.24 4.02	2.14 1.85	101 100	5.2 4.9	44 39	100 114	
10	47	, duod.	31/8 42 , ,	÷	19/8 3/9	5.64 5.43	4.34 2.93	1.30 2.50	105 72	5.3 3.4	46 25	105 94	0.20 0.15
11	36	, ,	2/1 43 , ,	:	2/4 10/4	7.60 7.43	5.75 5.68	1.85 1.75	92 86	5.1 4.5	46 38	101 103	0.30 0.25
12	64	, ,	31/5 43 , ,	:	25/5 7/6	6.45 5.80	4.66 4.16	1.79 1.64	102 110	4.9 5.4	39 42	98 96	0.25 0.30
13	25	, ,	7/10 43 , ,	÷	24/9 13/10	6.96 6.06	4.63 3.84	2.33 2.22	107 88	5.2 4.6	49 33	97 90	

14	36			9/9 43	÷	9/9 24/9	5.99 6.07	3.56 3.85	2.43 2.17	104 97	5.2 4.7	48 43	102 97	0.20 0.25
15	31			16/12 43	÷	7/12 30/12	6.47 5.52	4.51 4.01	1.96 1.51	88 86	4.6 4.9	30 33	98 88	0.20 0.20
16	42			4/1 44	÷	29/19 8/1	5.84 6.84	3.74 2.97	2.10 3.87	94 78	4.7 3.9	39 29	98 92	0.15 0.15
17	51			21/12 43	÷	14/12 27/12	6.36 5.69	3.69 3.20	2.67 2.49	90 101	4.5 4.6	40 37	116 102	0.10 0.10
18	40			25/3 46	÷	25/3 29/3	7.48 6.46	4.33 3.80	3.15 2.66	114 90	5.8 4.2	46 35	102 94	0.14 0.10
19	52			12/6 42	÷	9/6 18/6	5.90 5.03	3.40 2.53	2.50 2.50	89 70	4.6 3.4	38 30	94 99	0.10 0.10
20	40		Ca. ventr.	23/3 43	÷	23/3 2/4	7.24 6.80	5.75 4.59	1.49 1.71	103 91	5.0 4.4	48 38	96 102	0.30 0.20
21	64			24/3 44	÷	24/3 4/4	5.05 5.82	3.14 3.76	1.91 2.06	85 75	4.3 4.2	34 33	107 99	0.05 0.00
22	58			6/2 45	÷	6/2 7/2	5.33 5.56	3.35 3.79	1.98 1.77	97 98	4.4 5.0	40 36	94 97	0.12 0.10
23	64			17/4 46	÷	8/4 25/4	6.33 6.95	3.43 3.59	2.90 3.06	86 99	4.6 5.0	34 48	102 100	
24	76			11/11 44		9/11 27/11	5.92 5.71	4.08 3.65	1.74 2.06	90 110	4.6 5.4	35 40	109 102	1.10 0.05
				Relap. 3/12 44	Edema.	13/12	5.21	4.16	1.07	113	5.9	44	83	0.00



### Patients Operated for Ulcus Duodeni.

This group also consists of 9 patients, 8 of which gave no indications of chronic hypoproteinemia, and where neither the albumin values nor the fluid-salt balance control indicates that there has been any critical danger of edema. The postoperative minimum values were relatively low in 2 patients (Nos. 10 and 15). One of these will be described in more detail (No. 10) as the patient had had considerable passage delay after a gastro-enterostomy 6 months previously. During all of this time she had been controlled hematologically, always with normal findings. After resection she continued to have passage difficulties so that a new operation was indicated. On relaparotomy no signs of mechanical obstruction were found, and no signs of visceral edema in spite of the low albumin values. The cause of this, in spite of the fact that an edema preparedness must have existed, is probably to be found in the rigorous administration of fluid and NaCl. In the other patient (No. 15) the albumin fraction was so high that there was no edema preparedness. None of this group presented signs of external edemata or of fluid accumulation in the organism.

### Patients Operated for Cancer Ventriculi.

This group consists of 6 patients who differ from the above described in several respects. In the first place as regards the hematological picture, 4 of them (Nos. 19, 21, 22 and 24) have had a considerable pre-operative hypoproteinemia. The same is also true of No. 23 where the protein values are so high because of the considerable dessication exhibited by the patient due to pylorus stenosis. In only one case (No. 20) were the pre-operative protein values almost normal, even though this patient also exhibited a certain degree of hemoconcentration because of stenosis in the pylorus. The values found are therefore not an adequate expression of the protein concentration.

It is difficult to evaluate the postoperative protein values as all except one patient (No. 20) were administered considerable quantities of protein parenterally in the form of blood and serum transfusions varying from 2 to 13 transfusions. The result of this is that 2 of the patients (Nos. 21 and 22) show the reverse situation as the postoperative minimum values are higher than the

pre-operative. Nevertheless in 4 of them (Nos. 19, 21, 22 and 24) the oncotic pressure is so low that there is edema preparedness. Evident, subcutaneous edemata were demonstrated in only one of them (No. 24) and disappeared after 2 days.

In No. 24 the retention symptoms are so pronounced and so prolonged that re-operation was indicated, and was performed 3 weeks after the first resection. No indications of mechanical stenosis were found at this time. Nor were there any indications of visceral edema as the cause of the retention in spite of the fact that his total protein values were low. The albumin fraction, and consequently also the oncotic pressure, were here also relatively high.

#### **Stomach Resection Patients with Demonstrable Ankle Edemata.**

In order to obtain further information if possible as to the relation between hypoproteinemia, visceral edema and postoperative passage delay, a compilation is made in Table IV of the stomach patients who have had signs of ankle edema during the operative development. The patients suffering from affections of the circulatory system or the kidneys are excluded so that the edemata, as reported previously (ERSKIND 1945) have had hypoproteinemia as genetic factors in the majority of cases, and only exceptionally an excess of fluid-NaCl supply. In both these circumstances the possibility for visceral edema should be greater than in the material without edema.

This group includes 27 patients (Table IV). The cancer patients comprise 2/3 of these in spite of the fact that they only represent about 1/4 of the total stomach resection material. In only two of these (22 and 24) has retention been observed without any other explanation. The frequency of passage delay is thus percentually less than in the edema-free material, 7.4 and 7.7 respectively.

A couple of these edema patients will be described in greater detail as visceral edema was demonstrated during operation (Nos. 21 and 27). The first (No. 21) had considerable hypoproteinemia on admission without ankle edemata. The hypoproteinemia improved a good deal during the pre-operative treatment with blood transfusions. Laparotomy revealed considerable visceral edema which was particularly pronounced in the omenta and mesenterium but the intestinal wall was also somewhat thickened. In

Table

No.	Age	Diag.	Oper.	Complic.	Edema	Fluid Balance
1	49	Ulc. ventric.	$\frac{8}{12}$ 43 Res. ventric.	$\frac{14}{12}$ — $\frac{27}{12}$ Pneumonia	$\frac{27}{12}$ + $\frac{10}{1}$ :-	$\frac{8}{12}$ — $\frac{20}{12}$ Intake 30,000 Loss 19,200
2	57	Ulc. ventric. perf. Abscessus subphren.	$\frac{20}{10}$ 44 Incisio absce. subphren. $\frac{12}{12}$ 44 Res. ventric.	:	$\frac{13}{11}$ :- $\frac{4}{12}$ + $\frac{8}{12}$ :-	$\frac{12}{12}$ — $\frac{14}{12}$ Intake 8,250 Loss 3,900
3	45	Ulc. perf.	$\frac{2}{6}$ 45 Sutura. $\frac{6}{7}$ 45 Res. ventric.	:	$\frac{12}{7}$ +	$\frac{6}{7}$ — $\frac{11}{7}$ Intake 11,000 Loss 4,000
4	50	Ulcus duod.	$\frac{16}{4}$ 42 Res. ventric.	:	$\frac{20}{4}$ + $\frac{24}{4}$ :-	$\frac{15}{4}$ — $\frac{19}{4}$ Intake 14,600 Loss 5,000
5	43	Ulcus duod.	$\frac{22}{11}$ 43 Res. ventric.	Peritonit. loc. Neuritis.	$\frac{5}{12}$ + $\frac{12}{0}$ 44 :	$\frac{20}{11}$ — $\frac{7}{12}$ Intake 20,100 Loss 15,000
6	53	Hæmate- mesis permagn.	$\frac{31}{10}$ 44 Res. ventric.	:	$\frac{27}{0}$ + $\frac{9}{10}$ :	$\frac{10}{0}$ — $\frac{26}{0}$ Intake 20,000 Loss 16,800
7	52	Ulcus duod.	$\frac{4}{7}$ 44 Res. ventric.	:	$\frac{11}{7}$ + $\frac{13}{7}$ :-	$\frac{7}{7}$ — $\frac{11}{7}$ Intake 10,000 Loss 3,900
8	60	Ulcus duod.	$\frac{8}{2}$ 45 Res. ventric.	:	$\frac{14}{2}$	$\frac{10}{2}$ — $\frac{14}{2}$ Intake 7,200 Loss 7,100
9	48	Ulcus duod.	$\frac{6}{3}$ 45 Res. ventric.	:	Sl. + $\frac{11}{3}$ +	$\frac{4}{3}$ — $\frac{10}{3}$ Intake 16,500 Loss 8,900
10	68	Ca. ventric.	$\frac{20}{1}$ 43 Res. ventric. et coli	:	$\frac{27}{1}$ + $\frac{3}{11}$ ÷	$\frac{20}{1}$ — $\frac{26}{1}$ 43 Intake 14,600 Loss 7,850
11	70	Ca. ventric.	$\frac{23}{0}$ 42 Res. ventric. subtot.	:	$\frac{20}{0}$ +	$\frac{23}{0}$ — $\frac{20}{0}$ Intake 14,600 Loss 7,525
12	51	Ca. ventric.	$\frac{11}{0}$ 42 Res. ventric.	:	$\frac{16}{0}$ + $\frac{28}{0}$ ÷	$\frac{11}{0}$ — $\frac{15}{0}$ Intake 13,100 Loss 7,100
13	73	Ca. ventric.	$\frac{10}{0}$ 43 Res. ventric.	÷	$\frac{13}{0}$ + $\frac{17}{5}$ —	$\frac{10}{5}$ — $\frac{13}{5}$ Intake 4,200 Loss 3,400

## IV.

Sodium Chloride Intake	Date	Tot. Prot. %	Alb. %	Glob. %	Hgb. %	Red Blood Cells	Hemato-crit.	Clorid.
140 gr.	3/12	6.64	4.16	2.48	96	4.9	33	98
	14/12	6.33	3.34	2.99	81	5.14	31	92
	27/12	4.65	2.43	2.22	70	3.62	28	84
	10/1	6.14	3.29	2.85	80	4.44	32	102
48 gr.	13/11	6.34	3.28	3.06	88	4.16	27	90
	2/12	5.36	2.52	2.84	76	3.64	27	79
	8/12	6.80	3.71	3.09	68	4.08	35	81
80 gr.	5/7	7.20	3.86	3.34	111	5.9	37	98
	11/7	5.82	3.54	2.28	77	3.51	29	96
127 gr.	6/4	6.85	4.77	1.88	85	4.60	35	103
	20/4	6.20	4.20	2.10	75	4.10	32	105
	24/4	6.86	3.99	2.87				
100 gr.	17/11	5.74	3.85	1.89	107	5.70	40	97
	8/12	6.07	2.71	3.36	94	4.72	35	89
	4/1	4.44	2.21	1.98	103	5.18	48	83
	14/1	6.35	2.60	3.75	123	6.09	47	96
	12/9	6.31	2.77	3.54	93	4.74	42	93
50 gr.	23/9	5.10	3.16	1.94	42	1.90	15	102
	27/9	4.34	2.24	2.10	42	2.34	16	95
	5/10	4.84	2.71	1.13	48	2.16	21	103
	9/10	4.81	2.63	2.18	66	3.38	36	96
39 gr.	6/7	5.62	3.78	1.85	110	5.44	48	105
	11/7	5.02	3.48	1.54	83	4.1	30	101
42 gr.	31/1	6.36	3.69	2.67	90	4.46	40	116
	14/2	5.69	3.20	2.40	101	4.58	37	102
	19/2	5.90	3.40	2.50	96	4.88	30	100
90 gr.	5/3	5.46	3.82	1.64	72		20	100
	11/3	5.17	3.04	2.13				
	19/3	5.09	2.91	2.18	73	3.15	26	
121 gr.	19/1	5.39	3.36	2.03	109	6	40	100
	27/1	4.42	2.58	1.84	104	4.83	36	96
	3/11	6.33	3.98	2.35	100	4.96	41	103
124 gr.	9/9	6.75	4.28	2.47	95	4.70	43	105
	29/9	4.89	3.79	1.10	87	4.34	33	96
120 gr.	21/8	6.34	3.28	3.06	50	3.90	30	102
	16/9	5.12	3.13	1.96	86	4.20	32	102
	28/9	6.96	4.07	2.62	81	4.10	33	96
25 gr.	26/4	6.81	3.32	3.49	95	4.60	35	102
	13/6	5.04	2.62	2.42	64	3.13	26	99
	17/6	6.02	3.56	2.46	90	4.70	24	101

No.	Age	Diag.	Oper.	Complic.	Edema	Fluid Balance
14	59	Ca. ventric.	<sup>21</sup> / <sub>5</sub> 43 Res. ventric. subtot.	Retention	<sup>3</sup> / <sub>6</sub> +	<sup>21</sup> / <sub>5</sub> — <sup>2</sup> / <sub>6</sub> Intake 24,000 Loss 9,000
15	64	Ca. ventric.	<sup>20</sup> / <sub>9</sub> 43 Res. ventric.	:	<sup>26</sup> / <sub>9</sub> + <sup>30</sup> / <sub>9</sub> —	<sup>20</sup> / <sub>9</sub> — <sup>25</sup> / <sub>9</sub> Intake 11,800 Loss 5,000
16	42	Ca. ventric.	<sup>6</sup> / <sub>5</sub> 45 Res. ventric. et coli.	:	<sup>11</sup> / <sub>5</sub> +	<sup>5</sup> / <sub>5</sub> — <sup>11</sup> / <sub>5</sub> Intake 19,400 Loss 8,500
17	76	Ca. ventric.	<sup>9</sup> / <sub>9</sub> 43 Res. ventric.	:	<sup>10</sup> / <sub>9</sub> +	<sup>2</sup> / <sub>9</sub> — <sup>9</sup> / <sub>9</sub> Intake 20,500 Loss 10,700
18	65	Ca. ventric.	<sup>7</sup> / <sub>6</sub> 44 Res. ventric. et coli transv.	:-	<sup>12</sup> / <sub>6</sub> + <sup>15</sup> / <sub>6</sub> Sl. + <sup>20</sup> / <sub>6</sub> :-	<sup>7</sup> / <sub>6</sub> — <sup>12</sup> / <sub>6</sub> Intake 10,400 Loss 4,600
19	69	Ca. ventric. Diabetes mell.	<sup>3</sup> / <sub>7</sub> 44 Res. ventric.	:	<sup>10</sup> / <sub>7</sub> + <sup>17</sup> / <sub>7</sub> :	<sup>3</sup> / <sub>6</sub> — <sup>9</sup> / <sub>7</sub> Intake 9,350 Loss 8,600
20	77	Ca. ventric.	<sup>10</sup> / <sub>9</sub> 44 Res. ventric.	:	<sup>20</sup> / <sub>9</sub> + <sup>20</sup> / <sub>9</sub> :-	<sup>12</sup> / <sub>9</sub> — <sup>19</sup> / <sub>9</sub> Intake 13,500 Loss 8,500
21	42	Ca. ventric. Stenos. pylori	<sup>27</sup> / <sub>10</sub> 44 Res. ventric.	:	<sup>27</sup> / <sub>10</sub> Visc. edema <sup>1</sup> / <sub>11</sub> + <sup>6</sup> / <sub>11</sub> —	<sup>21</sup> / <sub>10</sub> — <sup>31</sup> / <sub>10</sub> Intake 23,100 Loss 12,800
22	76	Ca. ventric. Ileus.	<sup>13</sup> / <sub>11</sub> 44 Res. ventric. <sup>3</sup> / <sub>13</sub> Lap. expl.	Retention	<sup>27</sup> / <sub>11</sub> + <sup>1</sup> / <sub>12</sub> — <sup>13</sup> / <sub>12</sub> +	<sup>14</sup> / <sub>11</sub> — <sup>27</sup> / <sub>11</sub> Intake 28,250 Loss 15,500 <sup>1</sup> / <sub>12</sub> — <sup>12</sup> / <sub>14</sub> Intake 20,600 Loss 9,700
23	50	Ca. ventric.	<sup>18</sup> / <sub>4</sub> 44 Res. ventric.	:	<sup>3</sup> / <sub>5</sub> +	<sup>18</sup> / <sub>4</sub> — <sup>2</sup> / <sub>5</sub> Intake 25,400 Loss 11,100
24	64	Ca. ventric.	<sup>30</sup> / <sub>10</sub> Res. ventric.	:-	<sup>2</sup> / <sub>11</sub> ++	<sup>30</sup> / <sub>10</sub> — <sup>1</sup> / <sub>11</sub> Intake 7,000 Loss 2,350
25	70	Ca. ventric.	<sup>30</sup> / <sub>11</sub> 44 Res. ventric.	:-	<sup>9</sup> / <sub>12</sub> +	<sup>4</sup> / <sub>12</sub> — <sup>8</sup> / <sub>12</sub> Intake 7,500 Loss 7,800
26	60	Ca. ventric.	<sup>27</sup> / <sub>6</sub> 45 Res. ventric.	:-	<sup>1</sup> / <sub>7</sub> +	<sup>25</sup> / <sub>6</sub> — <sup>30</sup> / <sub>6</sub> Intake 12,850 Loss 7,500
27	70	Ca. ventric.	<sup>20</sup> / <sub>12</sub> Res. ventric.	:-	<sup>12</sup> / <sub>12</sub> + <sup>18</sup> / <sub>12</sub> — <sup>20</sup> / <sub>12</sub> +	<sup>20</sup> / <sub>12</sub> — <sup>24</sup> / <sub>12</sub> Intake 7,200 Loss 5,500

Sodium Chloride Intake	Date	Tot. Prot. %	Alb. %	Glob. %	Hgb. %	Red Blood Cells	Hemato-crit.	Clorid.
125 gr.	24/5	7.16	4.88	2.28	87	5.57	34	93
	3/6	6.00	3.06	2.94	91	4.52	40	94
	11/6	6.82	3.41	2.91	109	5.60	34	106
78 gr.	20/9	5.95	4.10	1.85	86	3.98	35	107
	26/9	4.69	3.00	1.68	65	3.43	30	93
	30/9	5.29	3.75	1.54	82	4.06	34	99
138 gr.	26/4	6.66	4.29	2.37	80	4.80	39	100
	17/5	5.59	4.28	1.31	77	4.40	39	97
130 gr.	8/9	5.19	3.29	1.90	92	4.64	28	119
	10/9	4.86	3.57	1.29	87	4.30	30	103
46 gr.	12/6	5.34	2.85	2.49	46	3.18		89
	15/6	6.08	3.33	2.75	80	3.96	39	89
	26/6	5.76	4.24	1.52	86	4.16	34	105
40 gr.	23/6	5.8	5.01	2.99	95	4.96	36	107
	10/7	5.56	3.09	2.47	62	3.57	26	102
	17/7	5.85	3.66	2.19	73	3.46	22	100
80 gr.	15/9	6.61	3.80	2.81	92	4.74	36	96
	20/9	5.17	3.40	1.77	92	4.70	31	106
	26/9	6.24	3.52	2.72	90	4.81	35	98
130 gr.	24/10	4.89	3.01	1.88	84	4.34	33	99
	27/10	6.03	3.74	2.29	85	4.04	33	115
	1/11	4.74	3.06	1.71	79	3.96	30	103
	6/11	6.88	3.78	3.10	85	4.36	34	99
108 gr.	9/11	5.92	4.08	1.74	90	4.60	35	109
	27/11	5.71	3.65	2.06	110	5.38	40	102
	1/12	6.03	4.46	1.57	113	5.94	44	103
	13/12	5.23	3.61	1.61	110	5.54	42	88
30 gr.	12/4	6.58	3.74	2.84	72	4.13	31	101
	29/4	4.88	3.31	1.57	91	4.78	35	87
	5/5	5.49	3.34	2.15	75	4.67	32	91
	30/10	6.03	4.01	2.02	91	4.2	30	89
30 gr.	2/11	5.07	3.02	2.05	82	4.18	35	100
	10/11	4.13	2.58	1.55	100	5.3	41	83
	2/11	6.11	2.96	3.15	107	5.26	42	
30 gr.	22/11	6.15	4.65	1.50	84	4.76	40	97
	5/12	5.96	4.45	1.51	67	4.39	36	95
	9/12	4.45	3.53	0.92	80	4.50	38	95
80 gr.	25/6	6.95	4.10	2.85	83	4.62	29	110
	30/6	5.60	2.51	3.09	97	5.06	39	100
	5/7	5.89	2.90	2.99	116	5.14	39	96
35 gr.	13/12	6.03	3.57	2.46	50	2.72	22	93
	27/12	7.03	3.81	3.22	84	4.22	33	99
	2/1	6.19	2.96	3.23	82	4.16	30	106

the postoperative period there was again a marked protein drop with the appearance of ankle edemata which disappeared on renewed protein substitution therapy.

The other patient (No. 27) had a more moderate hypoproteinemia but with ankle edemata. However, he had a rather pronounced secondary anemia and this seems to be a predisposing edema factor according to my edema material, possibly because of permeability alterations in the capillary net as a result of a relative hypoxia. After effective pre-operative protein treatment laparotomy revealed a considerable visceral edema in spite of the fact that the external edemata had disappeared by that time. In the postoperative period there was a marked reduction in the protein values. On the 12th day wound disruption occurred with protrusion of several edematous intestinal loops.

It can be assumed that both of these patients had prolonged visceral edemata in the postoperative period. However, passage during that time was perfectly normal. Further it is seen that in both of these cases the visceral edemata persist even through the external edemata are eliminated by pre-operative treatment. This is a definite indication that there may be many patients with visceral edemata in the above-described material with ankle edemata.

### **The Effect of Protein Treatment on Postoperative Passage Delay.**

Most of these retention patients who have shown signs of protein alterations have been subjected to an intense parenteral protein administration in the form of serum or blood. The effect has been very variable. Only in a very few cases has there been improvement of passage within a relatively short time after the protein restitution. However, this has by no means been the consequent result of the therapy. It cannot be compared with the positive effect of such treatment on hypoproteinemic external edemata. However, the observations made in the two above-described patients where there was slighter effect on the visceral than on the external edemata must be borne in mind, when evaluating a conclusion *ex juvantibus*. And its significance seems thus to be further reduced.

### Comment.

In the present retention material no accurate classification is made according to the time of onset of the retention or its degree. It appears that the patients who get their retention symptoms immediately after the operation behave in the same manner as those who develop their retention symptoms later on in the post-operative period. The same is true in general as regards the degree and duration of the retention symptoms. However, it will be found as a secondary phenomenon in massive retention that the post-operative protein fall in the serum is somewhat larger and that the regeneration time lasts somewhat longer than where the retention has been slight and of short duration.

In the uleus patients it is found that the protein values do not differ from the retention-free material, either in regard to degree or duration. Where hypoproteinemia has been demonstrated in these patients it is of acute origin in most cases, usually in the postoperative period, and has been of a temporary nature. This type of acute hypoproteinemia, even though it may be of a high degree, plays no part in postoperative passage delay. Moreover the same is true of the genesis of external edemata in surgical patients (ERSKIND 1945).

In chronic hypoproteinemia, however, the situation is not quite so clear. In the group of cancer patients we find signs of chronic hypoproteinemia with anemia with only one exception (No. 20). In all of these there is a decided edema preparedness, and in addition objective external edemata in one (No. 24). Even though relaparotomy of this patient revealed no visceral edemata, the possibility cannot be excluded that they have been present in a number of others, it may even be regarded as highly probable. However, it is not very probable that they play any significant rôle in the retention syndrome on the basis of the findings in stomach-operated patients with hypoproteinemic ankle edemata where the retention frequency is no higher than in the total material. This is also true of the relatively few of these edema patients where overadministration of fluid and NaCl has been an important factor in the edema genesis. The parallelism which exists between hypoproteinemia and external edemata is thus not found between hypoproteinemia and retention. The material does not indicate that the absence of accessory nutrient substan-



ces is a causal factor of retention. In a patient with pronounced symptoms of B-avitaminosis, postoperative stomach emptying was without complications. The ascorbic acid values were low, especially for carcinoma patients. However, they were not very much below the retention-free material.

### Summary.

1. Acute hypoproteinemia in this clinical material of stomach resections is not demonstrably related to postoperative passage delay.

2. Chronic hypoproteinemia with anemia is found with such frequency in the carcinoma material that a causal relationship cannot be excluded with certainty.

3. Patients with hypoproteinemic edemata do not have a higher retention frequency than the edema-free material.

4. Visceral edemata are no dominant causal factor in postoperative passage delay.

5. Protein therapy has therefore not so good effect on this postoperative complication, as on the hypoproteinemic ankle edemata.

### Zusammenfassung.

1. Die akute Hypoproteinämie hat in diesem Materiale von Ventrikelresezierten Patienten keine nachweisbare Relation zu postoperativer Ventrikelretention.

2. Eine chronische Hypoproteinämie mit Anämie wird in dem Materiale von Ventrikelkarzinomen nicht selten gefunden. Eine pathogenetische Relation gegen postoperative Passagebeschwerden kann darum nicht ganz ausgeschlossen werden.

3. Patienten mit hypoproteinämischen Ödemen haben keine grössere Retentionsfrequenz als das ödemfreie Material.

4. Viszerale Ödemen sind kein dominierender pathogenetischer Faktor bei postoperativen Passagebeschwerden.

5. Proteintherapie ist darnm nicht so effektiv bei dieser postoperativen Komplikation als bei den hypoproteinämischen Ödemen.

### Résumé.

1. Il n'y a pas de relation entre l'hypoprotéinémie aiguë et la retention gastrique postopératoire dans les cas de resections gastriques examinés par l'auteur.

2. Parmi les malades souffrants de cancer de l'estomac on trouve assez souvent de l'hypoprotéinémie chronique combinée avec de l'anémie. Pour cette raison on ne peut pas exclure une relation pathogénique avec la retention gastrique postopératoire.

3. Parmi les cas d'œdème hypoprotéinémique, la retention gastrique n'est pas plus fréquente, que chez les cas qui n'en ont pas.

4. L'œdème viscéral n'est pas un facteur d'importance dans la pathogénèse de la retention gastrique postopératoire.

5. La thérapie protéique n'a pas le même effet remarquable sur l'œdème viscéral que sur l'œdème chirurgical des tissus extérieurs.

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(BØRGE FABER, M. D.).

## Three Cases of Osteomyelitis in Children Treated with Penicillin.

By

HANS TONNESEN and BØRGE FABER.

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In the County Hospital in Næstved, three cases of osteomyelitis in children have been treated with penicillin. Briefly, the histories of the cases, which were almost alike, are as follows:

*A. — Girl, 3 years old.* Two weeks before admission a boil on the right knee. Three days before admission pain in the right hip. Temperature,  $40^{\circ}$  C. *Objectively:* Right hip joint fixed in slight outward rotation, flexion and abduction. Tenderness in the joint. *Roentgen:* No changes yet. Antistreptolysin titer, 800. Staphylolysin titer, 8—16. Sedimentation, 43. *Treatment:* Court-plaster extension; chemosept after usual schema; penicillin, 210,000 U., in all. *Course:* In the first days edema developed around the hip, and it looked as if an abscess was forming under the middle of the right ligament. The edema disappeared, however, in the course of a few days, and in the course of eight days the temperature gradually fell to normal. Four weeks after the onset of the disease, the extension was removed. There was free mobility in the joint. *Follow-up,* four months after the onset of the disease: clinical freedom from symptoms.

*B. — Boy, 15 years old.* Two weeks before admission two boils on the buttocks. Five days later, pain in the right hip. Temperature,  $40$ — $41^{\circ}$  C. Two days later, pain in the chest. Treated with sulfathiazol under the diagnosis of pneumonia. *Objectively at admission:* Symptoms of right-side pneumonia. Temperature,  $40.5^{\circ}$  C. Sedimentation, 106. Right hip joint fixed in flexion. Outward rotation. Abduction. Tenderness on the anterior side of the joint and along the left large saphenous vein. Venule blood: staphylococcus aureus. Staphylococcus antititer, 24. *Roentgen:* No changes yet. *Treatment:* Court-plaster extension; penicillin, 200,000 U. *Course:* After 100,000 U. of penicillin the temperature fell to normal in the course of eight days, but rose again to  $38.4^{\circ}$ .

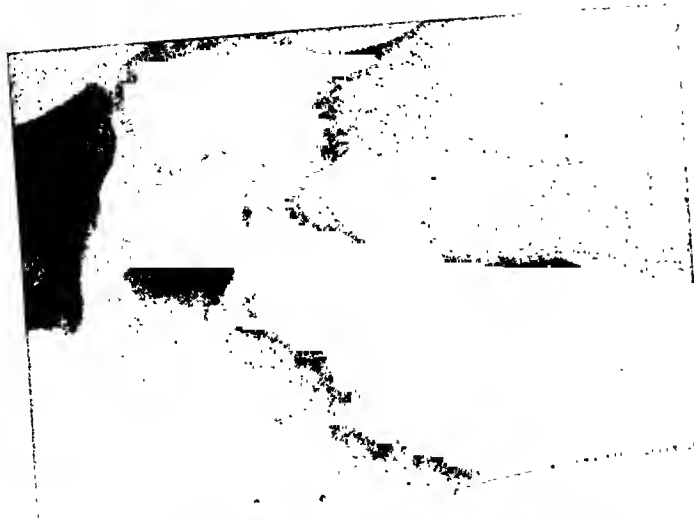


Fig. 3.

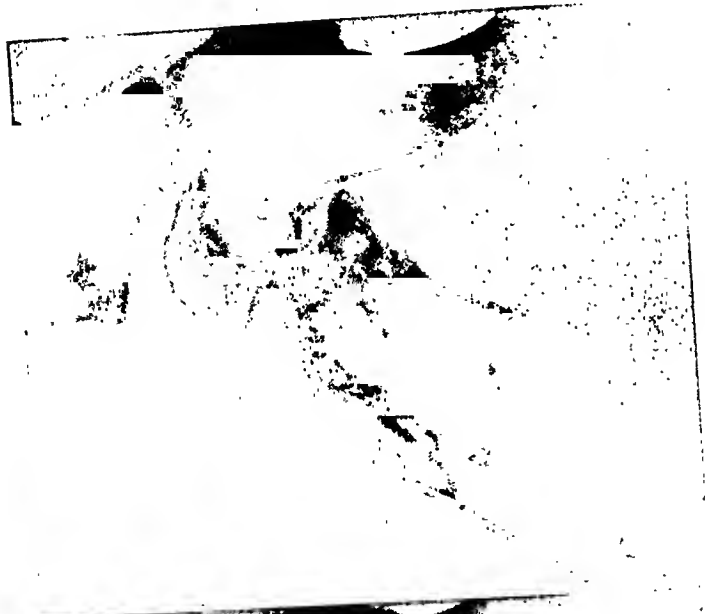


Fig. 2.



Fig. 1.

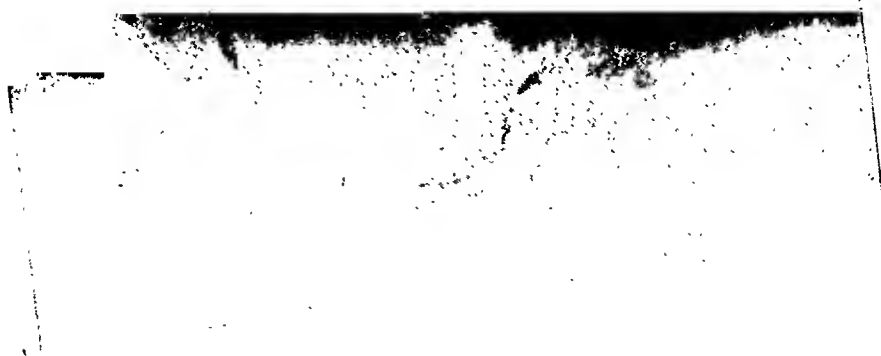
TØNNESEN AND FABER: Osteomyelitis in Children.



Fig. 5



Fig. 4.



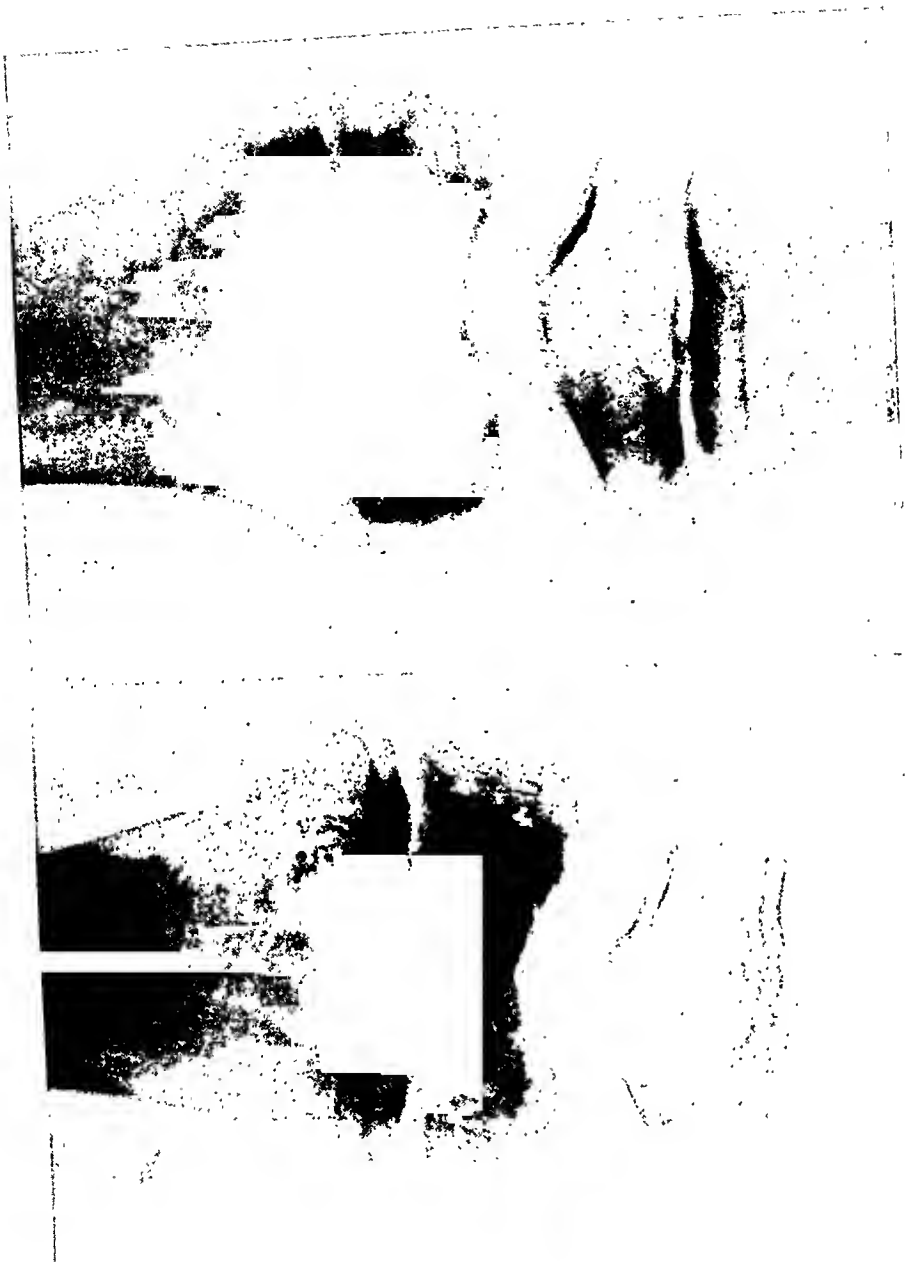
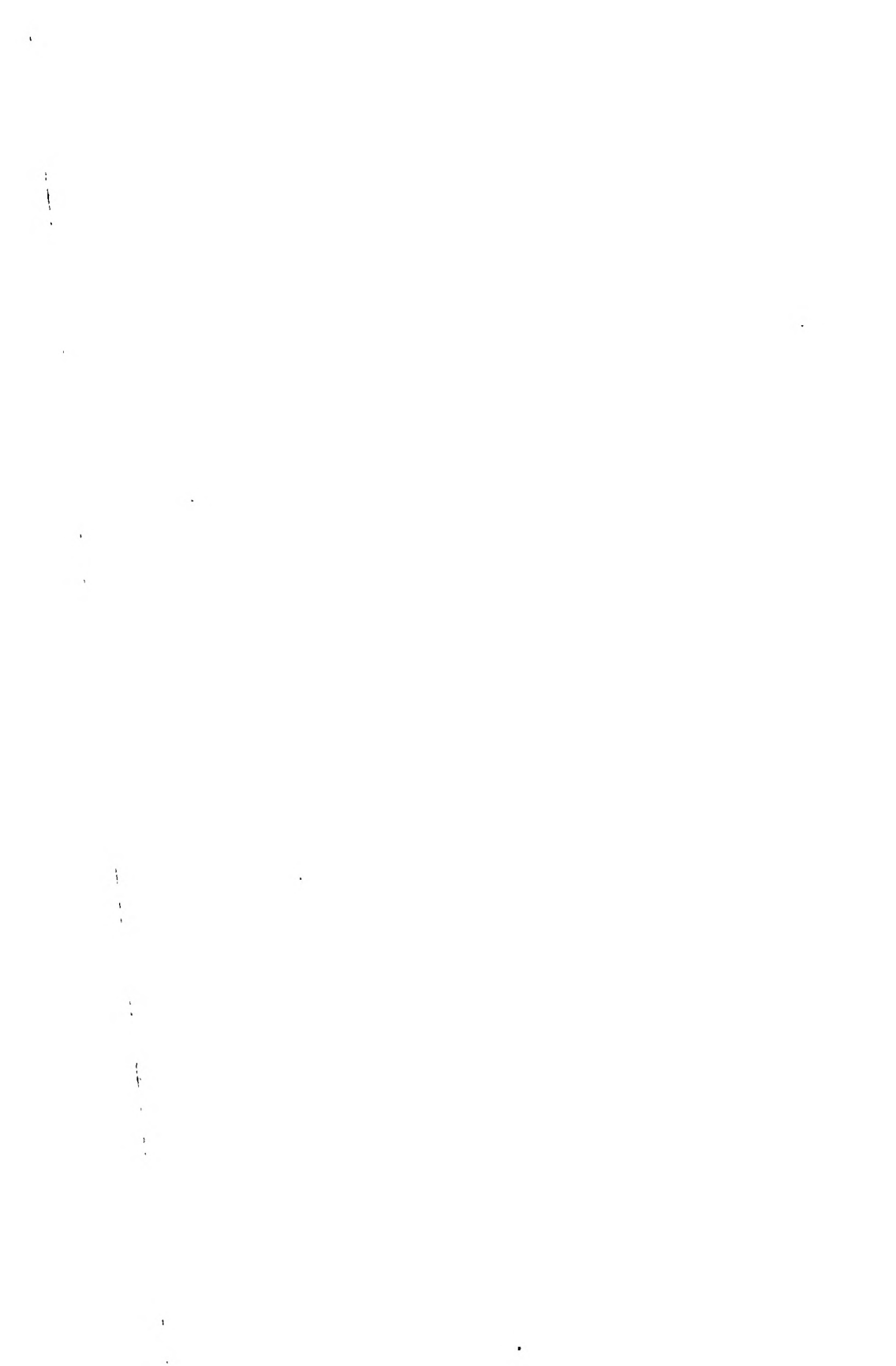


Fig. 7.

Fig. 6.



After another treatment with 100,000 U. it fell definitely. On the twenty-eighth day the extension was removed. The mobility was free. *Follow-up*, five months after the beginning of the disease: clinical freedom from symptoms.

*C. — Girl, 2 years old.* Four days before admission, contusion of right knee. Two days later, pain and swelling of the knee joint and rise of temperature. Treated at home, with sulfathiazol, for two days. *Objectively at admission:* Temperature, 38.5° C. Sedimentation, 33. Swelling and tenderness of right knee joint. Aspiration of 3—4 cc. of bloody, turbid fluid. Cultivation: staphylococcus aureus. *Treatment:* plaster splint; chemosept according to schema; penicillin, partly intra-articularly (10 cc., twice, in dilution 1 : 5), partly intramuscularly, 110,000 U. in all. *Course:* Lytic fall in temperature in the course of seven days. Splint removed in third week. Freedom from symptoms in eighth week. *Follow-up*, five months later: clinical freedom from symptoms.

The cure of these three cases of acute osteomyelitis and pyarthrosis, with no defect remaining, is a very striking proof of the efficacy of penicillin. Else the final result in cases of osteomyelitis of the upper end of the femur is usually severe invalidity, with restriction of the mobility and often accompanied by marked shortening owing to the inhibition of growth. Pyarthrosis in the knee joint, if left untreated, invariably ends in destruction of the joint and ankylosis.

We shall now demonstrate the roentgenologic changes, as they developed in the three cases.

### A.

- A 1. — At admission, three days after the onset of the disease: right hip joint normal (no reproduction of film).
- A 2. — Two weeks after the onset of the disease, after the end of the cure: There is now very slight decalcification over the acetabulum and in the upper end of the shaft of the femur. Medially in the neck of the femur, just below the epiphyseal line, there is a pea-sized rarefaction, where the osseous design is slightly blurred. Signs of incipient destruction. (Fig. 1.)
- A 3. — Four weeks after the onset of the disease: In a portion, about 4 cm long, of the upper end of the neck of the femur and the region of the trochanter, there are now diffuse decalcification and numerous close-set, hempseed-sized foci of destruction. No signs of reparative processes. (Fig. 2.)
- A 4. — Eight weeks after the onset of the disease: The rarefactions are now regressing and the osseous design is getting denser, closely approaching the normal. The neck is a little broad and plump. No decalcification. (Fig. 3.)



- A 5. — Four months after the onset of the disease: In the neck of the femur there are still scattered, but now fainter, rarefactions, separated by osseous tissue of increased density. The process of healing is thus continuing. The epiphysis and the joint-space are still normal. (No reproduction.)

### B.

- B 1. — At admission, three days after the onset of the disease: The hip joint normal. (No reproduction.)
- B 2. — Seventeen days after the onset of the disease, after the end of the cure: Slight thickening of the soft parts. In the neck of the femur and in the region of the trochanter there are now diffuse decalcification and several scattered, milletseed-sized foci of destruction, and a single larger, pea-sized, medially in the neck, just below the epiphyseal line. The epiphysis and the joint-space normal. (No reproduction.)
- B 3. — Nine weeks after the onset of the disease: Still slight thickening of the soft parts. The foci of destruction in the neck and the region of the trochanter have become larger and more numerous. At the same time, the density of the osseous tissue between them has increased, indicating a beginning development of reparative processes. (Fig. 4.)
- B 4. — Five months after the onset of the disease: In the neck of the femur there are now only faint remnants of the rarefactions, hidden in densified bone tissue. The epiphysis and the joint-space normal. (Fig. 5.)

### C.

- C 1. — At admission four days after the onset of the disease: Fusiform thickening of the soft tissues about the right knee joint. Slight diffuse decalcification in the distal end of the femoral diaphysis. No signs of destruction yet. The joint-space normal. (No reproduction.)
- C 2. — Twenty-five days after the onset of the disease, ten days after the suspension of the penicillin treatment: In the femoral epiphysis, especially in its medial part, there are now numerous close-set, millet- to hempseed-sized foci of destruction. The density of the osseous tissue around them is slightly increased, indicating incipient reparative processes. No narrowing of the joint-space. (No reproduction.)
- C 3. — Nine weeks after the onset of the disease: The foci of destruction have become a little clearer and more numerous. At the same time, the reparative processes, indicated by the densification of the osseous tissue, have become intenser. The joint-space and the soft parts are as before. (Fig. 6.)
- C 4. — Five months after the onset of the disease: The foci of destruction are now beginning to get filled with densified osseous

tissue. The articular surface of the femur is smooth, the joint-space normal. The soft parts are still slightly thickened. There is hardly any decalcification. (Fig. 7.)

C 5. — Nine months after the onset of the disease: About the same as at last examination. The rarefactions a little smaller, though. The joint-space normal. (No reproduction.)

About the roentgenologic findings we may thus note the following:

Since the roentgenologic changes, even in untreated cases, in the first two weeks are very inconspicuous and only show themselves in thickening of the soft parts and moderate, diffuse decalcification about the site of the infection, it cannot be expected that there will be any great difference between the pictures of the treated and the untreated cases. The difference cannot be expected until after two—three weeks, when the destruction of the bone in the untreated case begins to manifest itself. And even at that time the differences are slight. This is because the penicillin treatment, even if one acts quickly, cannot be instituted until the clinical symptoms have manifested themselves, that is on the second or third day; in other words at a time when the destruction of the bone or the joint capsule has already begun. The penicillin-treated case will therefore show the same symptoms of incipient destruction as the untreated; namely, about the second to third week scattered or more closely set, from millet- to pea-sized foci of destruction in the epiphysis.

The difference does not show itself until later in the course, at a time when the clinical symptoms in the penicillin-treated cases have almost entirely disappeared. While the destructive processes in the untreated cases have a tendency to become steadily intenser and more extensive, ending respectively in abscess and formation of sequestrae or in destruction of the joint and ankylosis, they will in the penicillin-treated have reached their maximum with the changes mentioned above: the scattered or more close-set, from millet- to hempseed- or pea-sized foci of destruction. These foci again get smaller, and it seems that they can heal completely, so that there is no formation of bone abscesses or sequestrae.

To sum up the matter it may thus be said that it is not possible by penicillin treatment to prevent the incipient destruction, but by early institution of the treatment (in the first three or four days after the acute symptoms have set in) we may succeed

in arresting the destructive processes at a time when they are still so limited that healing may eventually take place in such a manner that lasting destruction in the osseous tissue is avoided.

The conclusion that can be drawn from these three cases and from a fourth case of osteomyelitis, in the upper end of the humerus of a boy, 6 years old, who is now symptom-free, but in whom the roentgenologic changes have not yet become apparent, is that by timely instituted treatment it is possible to arrest the infection and obtain clinical freedom from symptoms in the course of one or two months or less; and that although the occurrence of the roentgenologic changes cannot be prevented, they can at least be arrested at an early stage of development and may later regress, and perhaps disappear entirely. We do not know yet, however, if the patients can be considered as finally cured, or if there perhaps are viable bacteria, still, in the small foci in the bones, and if these are liable to break up later. Neither do we know if secondary changes may not occur in the at present clinically symptom-free joints. These problems can only be cleared up by after-examination, for years, on a larger material of cases.

### Summary.

The authors report 3 cases of osteomyelitis in children, in which penicillin treatment resulted in the patients becoming clinically symptom-free. The course of the roentgenologic changes is described.

### Zusammenfassung.

Bei 3 Fällen von Osteomyelitis bei Kindern ist es gelungen, die Kranken durch Penizillinbehandlung klinisch symptomfrei zu machen.

Es wird der Verlauf der röntgenologischen Veränderungen beschrieben.

### Résumé.

Dans trois cas d'ostéomyélite chez des enfants on a réussi à faire disparaître les symptômes cliniques par un traitement à la Pénicilline.

Description de l'évolution des lésions radiologiques.

### Literature.

Penicillin (Reprint); U. S. A., 1944.

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## Low Spinal Cord Injuries Following Spinal Anesthesia.

By

EVERT SCHILDT, M. D.

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### 1. Introduction and Discussion of the Problem.

The introduction of the spinal anesthesia is without doubt one of the greatest advances in the field of anesthesiology. For the treatment of severe pain in the lumbar region, the American CORNING began epidural injections of cocain as early as 1885, which he changed to subdural in 1894. The first operation performed under spinal anesthesia was done by the German BIER in 1898. In the same year he was followed by the Frenchman TUFFIER and in the next by the American MATAS.

Because it was found that the spinal anesthesia as used then carried with it marked risks, the first enthusiasm was followed by criticism and scepticism. The reaction went so far that in several places this method of anesthesia was discontinued, a position which even today can be traced among some surgeons. However, in several clinics earnest work was carried on. The experimental work progressed and an increasing clinical experience was gained. For the modern development of spinal anesthesia we owe a great deal to the Belgian SEBRECHTS and the American BABCOCK. In this connection should also be mentioned PITKIN and JONES.

The circulatory disturbances which occur during spinal anesthesia were overcome by the use of proper drugs, especially those belonging to the ephedrine group. A more careful and exact dosage saved from paralysis of too great parts of the respiratory muscles, and in the modern anesthetic machines was found an effective weapon against the cases of respiratory collapse which in spite of everything would occur occasionally.

During the last decennium most surgeons have considered spinal anesthesia the method of choice in most of the larger operations below the diaphragm. The complete muscle relaxation makes possible an especially exact and careful surgery. Spinal anesthesia with percaine gives such a prolonged anesthesia that even the most time-consuming operations can be finished calmly without the anesthesia causing the patient any extra hardships. If the usual contra-indications are considered and if sufficient experience is had, the spinal becomes a very easy form of anesthesia. Very close to the ideal is the so-called "fractional method of SEBRECHTS". The combination with general anesthetics (preparations of barbituric acid, nitrous oxide, etc.), which have been used during the last few years, has proved itself a successful development.

From the very time spinal anesthesia was started to be used, reports are found in the literature of unpredictable, not seldom serious, complications of the nervous system. *It seems as if these communications have not attracted the attention which they so highly deserve.*

*Since the author just recently has experienced a very serious damage to the nervous system following spinal anesthesia with percaine, it has given him an occasion to try to investigate the risks with which one has to deal. This paper will deal only with those complications (cases of irritation and loss of function mentioned to a fuller extent below) from the caudal portions of the central nervous system which can occur in a more or less intimate connection with spinal anesthesia.*

## 2. Anesthetics.

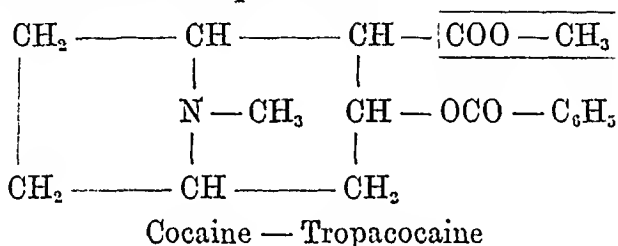
Considering the great number of anesthetics which have been developed, tried and again to a great extent rejected, this chapter must be limited to that which is of practical importance. *The purpose of the following is to create a systematic basis for the discussion.*

BIER used cocaine for his first spinal anesthesia. Because of its great toxicity the drug was soon rejected. BIER also tried tropacocaine, which even now is used on a smaller scale in a few hospitals. During the search for suitable, less toxic substitutes, in 1897 EINHORN and HEINZ discovered that esters of paraminobenzoic acid and aliphatic alcohols possessed properties of local anesthetics. Experimental medicine and chemistry combined proved able to produce impressive practical results. The development is in no way concluded but new drugs are introduced now and then.

### a. The Cocaine Group.

At least as an anesthetic for injection, cocaine is not used any more. The hydrochloric acid salt of *tropacocaine*, a stable preparation, is still but not to a great extent used as a spinal anesthetic. There is no danger of damage to the tissues. The toxicity is much less than that of cocaine. Serious intoxications in humans are hardly ever seen. At present tropacocaine is used only in the form of hyperbar solutions in a concentration of 5—10 %.

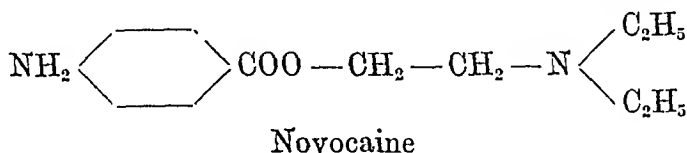
The nucleus is made up of tropane, a combination of one piperidine and one pyrrolidine ring. If one hydroxyl group with benzoic acid and one carboxyl group with methyl alcohol are added, cocaine is produced. If the methylated carboxyl group is removed, the result is tropacocaine.



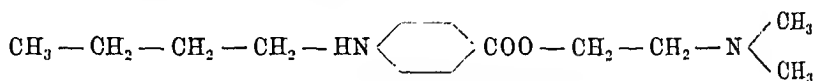
### b. The Novocaine Group.

By combining paraminobenzoic acid with ethyl alcohol, in 1905 *novocaine* was produced (EINHORN), identical with the Anglo-Saxon *procaine* and the Swedish *aethocaine*. Its action is relatively short. The tissues are not harmed. The toxicity is only a fraction of that of the cocaine. Especially if the solutions are weak, the intoxications are rare and harmless. For spinal anesthesia, most often the drug is used in concentrated solutions (up to 7 %). A few surgeons prefer the dry crystals (usually 0.1—0.2 Gm.) which, just before the injection, are dissolved in the spinal fluid or in a normal saline solution.

Novocaine is a part of many preparations, the combination of which varies according to the demand upon the concentration viscosity and specific gravity. Allocaine, durocaine, gravocaine, neocaine, parocaine, planocaine, syncaine, scurocaine and spinocaine are from different countries and pharmaceutical houses.



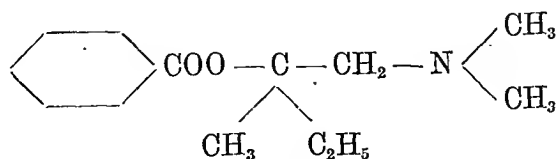
Close to the novocaine are the identical preparations *pantocaine* and *decicaine*. The toxicity is several times greater than that of cocaine but on the other hand the anesthesia lasts so much longer. The hydrochloric acid salt preparations are stable. The tissues are not harmed. The drugs are used both in hyper- and hypobar solutions but always in quite a weak concentration (at the most 1 %). In the comparison with novocaine, it is found that in the amino radical one hydrogen atom has been replaced by one butyl group. The ethyl groups have been exchanged for methyl radicals. Considering its actions, pantocaine (decicaine) forms a transition to the percaine group. It is the opinion of the author that pantocaine (decicaine) cannot replace percaine. The action of the former drugs is much less sure and during certain operations of altogether too short a duration.



Pantocaine (Decicaine)

*Tutocaine* is related to novocaine but shows also certain similarities to cocaine. This preparation is not used by us any more. It is more toxic than novocaine. In spinal anesthesia it is used in a concentration of 1—2 %.

For the sake of completeness, *stovaine* and *alypin* are mentioned. Being related to novocaine, they closely resemble each other. Earlier these preparations were used a good deal, especially in England and France. However, they harm the tissues severely (see below regarding the so-called *stovaine tabes*), and the injections are painful. These drugs are now supposed to have been discontinued.

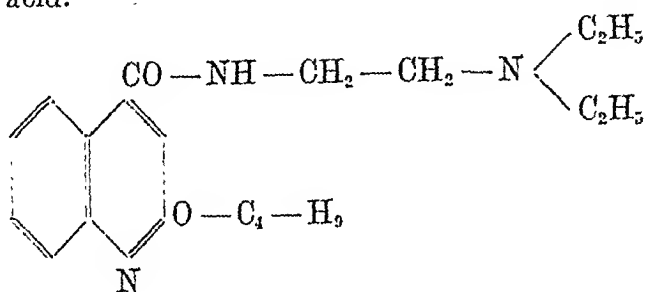


Stovaine

### c. The Percaine Group.

At present *percaine* dominates our country. It is identical with the American *nupercaine*. The hydrochloric acid salt preparation is unstable because of its great sensitivity to alkali. The toxicity is

great, markedly more so than that of the cocaine. However, since the anesthetic properties are many times greater, the doses can be made so small that the drug still can be said to possess a "wide margin of anesthesia". The preparation has a *very great affinity for nerve tissue*. Because of this the anesthesia lasts longer than that from any other now known local anesthetic agent. As a rule, for spinal anesthesia a hypobar solution is used in the strength of 1:1,500. The structure of the molecule is formed by a quinoline carbonic acid.



Percaine

### 3. Review of the Literature.

The literature covering low injuries of the spinal cord following spinal anesthesia is quite large but not impossible to review. There are reports in which the connection between the spinal anesthesia and the symptoms produced is very doubtful. Among others, some of LOESER's informations belong to these. Larger series of systematic neurologic examinations of patients who have had surgery under spinal anesthesia are lacking. It seems possible that cases of milder loss of function could be found during such a search. It could be expected especially that milder caudal syndromes have been missed. Examination of our latest almost 200 cases of spinal anesthesia using percaine 1:1,500 have given negative results. Neither have histological examinations of the spinal cords from three patients, who died shortly after surgery under spinal anesthesia, given any positive results.

The purpose of the following review is to give the necessary basis for the discussion, and to supplement the author's own material. *Especially should it be mentioned that there are many studies of up to a few thousand cases in which there are no complications. It is necessary to point out this as a counterbalance against the alarming series given below.*



### A. Experimental Studies.

Following injections of *stovaine* into the spinal channel of *rabbits*, VAN LIER found certain transient, light changes. Nerve roots and spinal ganglia were spared. Also WOSSIDLO injected into *rabbits* solutions of 4 % *stovaine*, 5 % *tropacocaine*, 5 % *novocaine* or 4 % *alypin*. He concentrated his attention on the Nissl bodies. His findings were similar to those of VAN LIER. The changes were most marked near the site of the injection and in the posterior portions of the spinal cord. SPIELMEYER studied the effects of *stovaine* upon the spinal cords of *dogs and monkeys*. He noticed marked changes in the large polygonal nerve cells of the anterior horns (swelling, rounding, chromatolysis, achromatosis, disappearance of the cell fibrils), peripheral degeneration of the myelin sheath (osmium) and certain degeneration of the posterior columns. KLOSE and VOGT worked with *rabbits and dogs* which were injected with *tropacocaine*, *novocaine* and *stovocaine*. The changes, which were most marked after 3—7 days, were practically the same as those observed by SPIELMEYER. Only the motor cells were affected. The sensory cells were spared, even in the spinal ganglia. DAVIS, HAVEN, GIVENS and EMMETT worked with *novocaine* preparations (spinocaine, scurocaine and gravocaine) on *dogs*. A constant finding was a meningeal reaction with cellular proliferation and infiltration (mostly lymphocytic). The cellular changes were like those mentioned above. Silver stains revealed changes of the axis-cylinders in the lumbar and sacral segments. After 3—4 weeks peripheral myelin sheath degeneration was detected, especially caudal. In a few cases were found ascending degenerations. LUNDY, ESSEX and KERNOHAN fixed the dose of *procaïn* (*novocaine*) which gave *dogs* a permanent paralysis. This was accomplished by injecting for instance 5 ml. of a solution the concentration of which was between 17.5 and 20 %. The histological lesions were found in myelin sheaths and axis-cylinders. The nerve roots were without remark. MACDONALD and WATKINS worked on *cats* with *procaïne* (*novocaine*) solutions. With increasing concentration (from 5 %), they observed an increasing number of permanent paralyses, sensory disturbances and lesions of the rectum and the bladder. Several authors have proved that *the anesthetic agent proper is the cause of the observed biological and microscopic changes*.

*Summary.*

*Tropacocaine, novocaine, alypin and stovaine cause, in certain cases among experimental animals, definite spinal cord lesions. The disturbances are either reversible or permanent, and in the later cases consist of paralyses, sensory disturbances and lesions of the bladder and the rectum. The injuries are located in the spinal cord and are most marked near the site of injection. Nerve roots and spinal ganglia are spared as a rule.*

**B. Clinical Literature.****a. Meningeal Reactions.**

The meninges are markedly sensitive to surgical interference. Reactions can be noticed already after injections of physiological saline solutions (SICARD, SALIN and MADER) which must be explained in connection with the peculiar composition of the spinal fluid. Usually the reactions are estimated according to the changes of the number of cells, and the content of globulin, albumin and sugar.

In the literature are reported meningeal reactions following the use of drugs from all the groups, as has been mentioned above, thus from cocaine (REVAULT, AUBOURG, QUINARD), tropacocaine (KREY), novocaine preparations (HYSLOP; LECLERC; IASON, LEDERER and STEINER; BROCK, BELL and DAVISON; BACKER-GRØNDAHL; et al.), pantocaine (LIENHOOP), stovaine (MESTREZAT and RICHE) and percaine (BACKER-GRØNDAHL; BRUGEAS; BROCK, BELL and DAVISON). *The reactions are usually very mild and transient.* The increase in cells disappears first, the protein reaching normal levels later. Only in exceptional cases does the meningeal irritation reach alarming degrees, of which testifies the following case, published by WEIGELDT.

A woman, aged 49, was operated upon on Oct. 25, 1918, under spinal anesthesia (probably 0.15 Gm. novocaine dissolved in 2 ml. spinal fluid) for a prolapse. On Jan. 22, 1919, the symptoms set in which by June consisted of *flaccid paralysis of both legs, sensory disturbances up to the costal margins, and urinary difficulties. Several spinal punctures gave no fluid. Laminectomy with exposure of the spinal cord showed almost complete obliteration of the subdural space.* Death due to urosepsis in Aug. 1921. *Section showed from a point 11 cm. below the olivary body caudal and clear down such intensive and extensive adhesions that a probe could not be passed between the dura and the myelon. Microscopic examinations showed chronic inflammation of the leptomeninges, while the cord*

*itself is reported not to have undergone any marked changes.* (This seems strange. Because of the prominent symptoms, at least evidences of degeneration would be expected.) The author considers the nervous symptoms as due to pressure and circulatory disturbances.

WEIGELDT reports also another case of similar nature in which, after a spinal anesthesia with 0.15 Gm. of novocaine in 2 ml. spinal fluid, paresis was caused in both legs, slight sensory disturbances to the groins but no difficulties with the urination and defecation. Neither in this case did repeated lumbar punctures give any spinal fluid. Gradually there was a certain amount of improvement but even months later the patient could not walk. Symptoms of the same type have been observed following a subdural injection of salvarsan.

It is of interest to point out that *the laboratory findings in these meningeal irritations are not in proportion to the subjective difficulties* (IASON, LEDERER and STEINER; BACKER-GRONDAHL, et al.). This makes one think of the so-called "dural leakage".

#### b. Damages to the Spinal Cord.

Low lesions of the spinal cord usually manifest themselves mainly through phenomena of *irritation* (parasthesias, pains, cramps) or *loss of function* (sensory disturbances, pareses, paralyzes, disturbances of bladder and rectal function). *The symptoms appear at once or may become noticeable only after days or months. The findings are very much mixed up and follow no fixed rules either during the beginning, at the time of their greatest intensity or during the period of repair.*

Following the use of *tropacocaine* GOLDSCHWEND saw two cases of paraplegia (in 100 cases) and BORBERG noticed a case of parasthesia and light sensory disturbances.

There are many reports of severe damages following the use of preparations in the *novocaine* group. ANDRÉ-THOMAS (0.08 Gm. of novocaine in a 4 % solution) saw pareses of the legs, low sensory disturbances, bladder and rectal disturbances. BRAIN (2 ml. spinocaine) has seen marked pareses, bladder and rectal lesions (death due to infection). CRITCHLEY (planocaine) reports two cases of paralysis of the legs and difficulties of the miction and defecation (one man died in about seven weeks). ELSTAD (0.2 Gm. parocaine dissolved in 3—4 ml. of spinal fluid) found marked paralysis (death due to paralysis of the respiration in a few weeks). FERGUSON (heavy durocaine in several cases) had four patients who became unfit for work for periods of three to nine months. FRANKE reports two severe cases of pareses, sensory disturbances

and difficulties with the miction and defecation. One of these died after six days. An autopsy record of this patient is given below. The other could hardly walk after 11 months. GOVSEJEV and ROSSIN (novocaine) saw paralyses of the legs, sensory disturbances, incontinence of urine and feces, and trophic ulcers. The patient not yet recovered after thirteen months. KELMAN and ABBOTT (spinocaine) report a case with paresis and sensory disturbances of one leg, and bladder and rectal lesions which were not overcome after almost two years. LIENHOOP has seen several cases of paresis following the use of 10 % solution of novocaine. NYGAARD saw symptoms of the cranial nerves and milder sensory disturbances. (It is possible that the death was due to respiratory paralysis.) WEIGELDT related the above-mentioned severe cases following the use of novocaine.

Among others KELMAN and ABBOTT, PEIRSON and TWOMEY, and RIESER report milder injuries.

To the group of cases injured by novocaine belong a few completely studied autopsy cases which herewith are reported in detail.

**BRAIN's case.** Male, 33 years of age. Surgery for ruptured disc done under spinal anesthesia using 2 ml. spinocaine (= 10 % novocaine, etc.) injected between L III and L IV. About one week after the operation, pains were present in the lumbosacral region. After about one month there were pains in the legs. Then developed pareses in certain groups of muscles of the arms, legs and trunk, followed by muscle atrophies. No sensory disturbances. Lesions of bladder and rectum. The spinal fluid showed increase of the protein but no excess of cells. Patient died from infection. At the time of the autopsy, the brain, the spinal cord and a few peripheral nerves were examined. *Only the spinal cord and its covering membranes showed macroscopic and microscopic changes. Over the dorsal surface of the sacral portion of the spinal cord was a thick exudate, 1.5 × 0.6 cm. in size (probably secondary to the changes in the cord). The myelon was brownish-grey and soft from Th XII and downwards. In it were a few minor hemorrhages. Microscopically there was a complete necrosis of the dorsal portion of the sacral cord.* The changes were less marked higher up in the spinal cord. Changes of the blood vessels were the dominating factor. Mainly were the veins involved (endophlebitis, hyaline necroses, thromboses). No changes were found above the medulla oblongata. BRAIN considers that the vascular changes were the cause of the whole picture of the disease.

**FRANKE's case.** Male, 24 years of age. Surgery for varicosities done under spinal anesthesia, 4 ml. of a 5 % solution of novocaine. During the operation the patient was in a poor condition. Two days later, pain in the abdomen and in the legs. Pareses and sensory disturbances in

the lower portions of the body. Damage to the bladder and the rectum. Death in six days, mainly from pneumonia. The autopsy showed pleurisy and pneumonia. *In the lumbar region the spinal cord was swollen for a distance of about 5 cm. Above that a somewhat softer area. Swelling of the sections of the spinal cord. Hemorrhages in the myelon clear up to the medulla oblongata. Among microscopic changes are mentioned especially hemorrhages and damages of the myelin sheaths. "Die Grundbündel" (the main trunks) are reported as undamaged.*

Following *pantocaine* (decicaine) anesthetics damages are mentioned by LIENHOOP (several cases of paralysis following the use of 0.8 % solutions); also by PEIRSON and TWOMEY (mainly disturbances of the bladder function).

NONNE and DEMME saw two serious cases caused by *tutocaine*, one terminating in death.

*The case of NONNE and DEMME.* Anesthesia with one ampoule of *tutocaine*. After the anesthesia marked paresis in both legs, sensory disturbances from L III and downwards, incontinence of urine and feces, prolapse of the rectum, and a sacral pressure sore. Death in less than three months due to infections in the urinary system and the bed sore. The autopsy showed — besides tuberculosis of the lungs and the bowels — a severe infection of the urinary tracts. *String-like adhesions between the dura and the pia mater over the lower portion of the myelon. Microscopically were found thickenings of the leptomeninges in the lumbar and sacral portions of the cord. No inflammation present. Almost complete necrosis of the dorsal and lower portions of the spinal cord. Higher up was seen an ascending degeneration of the fasciculi of Goll. The brain was without remark.*

Damages from *stovaine* are mentioned among others by ASHWORTH (paresis of the legs, pain, urinary retention; return of normal health in a short time), BAZY (marked caudal syndrome with urinary retention), CRITCHLEY (paresis in remaining leg, sensory disturbances, retention of urine and feces, death due to uremia. No autopsy. Also one less severe case), FERGUSON (several severe cases), RICHE (two pareses to the peroneus muscles in 4,600 cases), JEAN and SOLCARD (one temporary and one permanent paralysis in 1,038 cases), MÜNCHMEYER (five temporary paralyzes in more than 2,000 cases), and VIOLET and FISHER (eight cases of paralysis). HASLER states that the frightening expression *stovaine-tabes* has been used in England.

Damages following the use of *percaine* are reported by BROCK, BELL and DAVISON (in one case paresis, sensory disturbances, incontinence of urine and feces; in another case practically a transverse lesion at the level of Th XII, with death — autopsy

report below), and SCHAUPPISSE (a temporary paralysis of the legs with return to normal health in ten days).

*The case of BROCK, BELL and DAVISON.* A severe infection of the urinary tract. *Hyperemia of the leptomeninges, especially in the upper lumbar region. Hyperemia of the myelon, corresponding to the sections Th VIII—Th X. Softening of the spinal cord corresponding to Th XI—L I, especially on the dorsal side. Microscopically was found a marked demyelination, fatty deposits, especially in the periphery of the cord, evidences of an ascending degeneration, marked changes in the axis cylinders, color changes, and a mild glial reaction.*

Besides the related examples of damages following spinal anesthesia are many others in which information is lacking concerning the anesthetic preparation used and its dose. Among these are cases reported by BOISSEAU; BROCK, BELL and DAVISON; COPELLO, DIMITRI and NAIM; CRITCHLEY; DUJARIER; COTTALORDA; LEPOUTRE and PAUL, and others.

The review shows that *mild, more marked or severe, at times fatal injuries of the nervous system are seen following spinal anesthesia in which has been used tropacocaine, preparations of novocaine, pantocaine, tutocaine, stovaine or percarine. The relatively few cases of autopsy show us that the changes are in the spinal cord or its membranes and that they are most marked near the site of injection.* Pathologically the changes vary much both as to extent and intensity; in the more severe cases they advance clear to necrosis.

#### 4. The Author's Own Material.

To investigate, if possible, the presence, degree and kind of spinal cord lesions following spinal anesthesia, the author has sent the following questionnaire to those hospitals in the country where a large amount of surgery can be expected to be done.

A. Approximate number of spinal anesthetics done in your department per year?

B. What anesthetic is used? If several are employed, what are the approximate proportions between them?

C. What technic is used as a rule? Different technics for low or high anesthetics?

D. Have in your experience such lesions occurred as have been described above (i. e. bladder and rectal difficulties, and motor and sensory disturbances in the lower part of the body)?

E. Have you knowledge of any cases of nervous lesions following spinal anesthesia? When and where have they occurred?

The questionnaire has been sent to all the surgical, gynecological, orthopedic and the surgical departments for children in the country; also to all hospitals not divided into departments as well as to similar institutions. A total of 121 blanks have been sent out and most of these have been answered. *The author wishes to express his sincere thanks to the surgeons in the country for the willingness with which they have met the request for information. The results obtained must be considered representative of Swedish surgery.*

### A. The Present Use in this Country of Spinal Anesthesia.

	Spinal Anesthesia is used		
	In a large or fairly large no. of cases	In a lesser no. of cases (max. 25 per year)	Not at all
Surgical Departments . . . . .	32	1	1
Hospitals not divided into depts	38	13	3
Gynecological depts. . . . .	5	2	2
Orthopedic depts. . . . .	2	3	1
Surgical depts. for children. . . .	—	1	1
	77	20	8

In the answers which the author has received, it is reported that well over *23,000 spinal anesthetics are used per year*. The real figure for the whole country can be estimated to lie between 25,000 and 30,000.

### B. The Anesthetics in Use.

*Only percaine, novocaine* (procaine, aethocaine), *decicaine* (pan-tocaine) and *tropacocaine* are used. The *approximate* proportions between these drugs are:

percaine	in about 17,500 cases
novocaine	» » 4,000 »
decicaine	» » 1,000 »
tropacocaine	» » 500 »
	<hr/> 23,000 cases.

*Percaine* is used almost altogether in a hypobar solution of the strength of 1:1,500. In a few hospitals, however, heavy percaine has been mentioned. This drug is used mainly in higher

spinal anesthetics. *Novocaine* is used in markedly varying concentrations (from 1—7 %). A few surgeons prefer novocaine in crystals (0.1—0.2 Gm.) dissolved in the spinal fluid just before the injection. Novocaine is used mostly in low, less often in higher anesthetics. *Decicaine* is used, especially in low anesthetics, in the heavy kind but lately in a hypobar form for high anesthetics. *Tropocaine*, finally, is used mostly in low anesthetics and that in a lesser degree only. The concentration of the solution is as a rule 5 %, in exceptional cases 10 %.

### C. Technic.

As a rule the injection is done at a safe distance below the conus terminalis. Only one surgeon injects for high anesthesia between Th VII and VIII, according to his own report without any complications. When using hypobar solutions, the first injection is usually done with the patient lying on his side. Later the patient is turned on his abdomen. It is seldom that the puncture is done with the patient in prone position. Heavy solutions are injected most often in a sitting position. At least until now, in giving high anesthetics almost always fractional doses are used. However, this is done with many personal variations of Sebrechts's original method. In low anesthetics as a rule, a single dose is given.

### D. Observed Cases of Postanesthetic Damage of the Nervous System.

Through the questionnaire have been reported six such cases which have been observed during the last three years (1943—1945). A few cases have been indefinite and hard to evaluate. Because of this they have been excluded from this study. Below, the cases are discussed in detail.

#### Casuistics.

*Case No. 1.* Surgical Department I, Allmänna and Sahlgrenska Sjukhuset, Gothenburg. A male, 67 years of age. Chronic gastric ulcer with penetration into the pancreas. Cared for in the department from January 19 to May 22, 1943. Surgery on January 28. Resection according to Billroth II. Spinal anesthesia using 14 ml. of Ciba's original percaïne, solution 1 : 1,500. Fractional method. Nitrous oxide.

Feb. 15. Since surgery bilateral paresis of the peronei. Mobility increased during the last few days. Walks without support.



Feb. 22. Steady improvement of the paresis of the peronei. Walking fairly well now.

June 15. Neurological examination. Decreased strength in both peroneus groups, more on the right. Pricks on the dorsum of the feet can hardly be felt. The decreased sensibility extends upwards to about one third of the anterior aspect of the legs. Some bilateral decrease in the strength of the flexors of the toes.

June 11. Wasserman reaction negative. Aug. 7. Starts working. Aug. 21. Left foot the better. Subjectively decidedly improved.

*Summary.* A male, 67 years of age. Spinal anesthesia using 14 ml. of Ciba's original percaine. Solution 1 : 1,500. Fractional doses. Immediately following surgery bilateral motor and sensory disturbances involving segments L IV—S I. No symptoms from bladder or rectum. Definite improvement in six months.

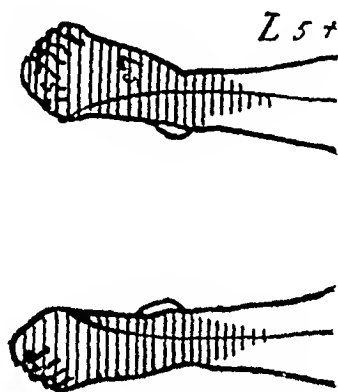


Fig. 1. Approximate extension of the sensory disturbance.

*Case No. 2.* The Surgical Department, The Nyköping Hospital. Woman, 32 years of age. Cholelithiasis. Cared for in the department from Oct. 9—29, 1943.

Oct. 9. Cholecystectomy. Spinal anesthesia with 15 ml. Ciba's original percaine. Solution 1 : 1,500. Fractional doses. Nitrous oxide and ether.

Oct. 29. Uncomfortable and painful paresthesia right leg. Continued ache necessitating the use of tablets. The sensibility lost in the anterior aspect of the leg extending from the groin to the knee. The leg feels unsteady.

Nov. 24. Improved. Now walks without support. Must constantly take tablets for the ache. The sensibility now normal.

Dec. 14. Improved. Walks well but tires easily. New paresthesias in the left leg. If left big toe is stubbed, pains radiate upwards.

*Summary.*<sup>1</sup> Woman, 32 years of age. Spinal anesthesia with 15 ml. of Ciba's original percaine. Solution 1 : 1,500. Fractional doses. Disturbances probably immediately after surgery (sensory and motor — the

<sup>1</sup> When this work was finished I got the following completing informations. Immediately after the anesthesia severe pains in the back and both legs. Cramps in the legs. The pains continued for one year and a half. Permanent ache with

leg felt unsteady), involving the segments Th XII—L III on the right side. Paresthesias both legs. No bladder or rectal disturbances. Definite improvement in three months.

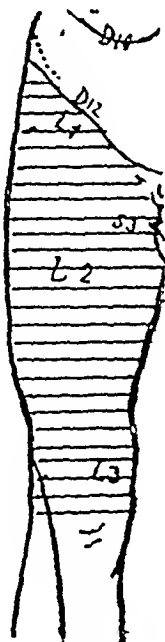


Fig. 2. Approximate distribution of the sensory disturbance.

Case No. 3. Surgical Department, Akademiska Sjukhuset, Upsala. Male, 54 years of age. *Chronic cholecystitis and cholelithiasis with exacerbation*. Cared for in the department from July 7 to Sept. 9, 1944.

July 10. Cholangiography, cholecystectomy, probing of the common bile duct, gastric fistula (surgical lesion of the duodenum). Spinal anesthesia with 23 ml. of Ciba's "original percaine", 1 : 1,500. Fractional doses. During the operation cyanotic and unconscious. However, the systolic blood pressure did not fall below 70 mm./Hg (palpatory method). The sensation corresponding to the segments S I—V is lost immediately after the operation and greatly decreased corresponding to L I—V. Paresis both legs. Able to move the hip joints slightly but not the knees or the ankles. Unable to void. Cannot feel the catheterization. Anal sphincter relaxed. No paresthesia. No pains.

July 17. Slow improvement of the nervous symptoms.

exacerbations. In 1945 weakness and fatigue in the right leg. Numbness in both feet. Bladder and rectal difficulties.

Examination in June 1946. Sensory disturbances of smaller areas of both legs. Knee jerks exaggerated. Achilles jerks absent. Bilateral positive Babinsky. Spinal fluid normal. W. r. neg.

Right hip joint: slight paresis of ext.

» knee » : marked paresis of flex., slight of ext.

» ankle » : » » » ext., » flex.

Left knee » : slight paresis of ext. and flex.

» ankle » : » » » »

July 28. The sensory disturbance involves now only S III—V. Subjectively also decreased sensibility over the dorsum of both feet. Can now feel the catheterization. Unable to void and to control the defecation. Although with markedly decreased strength, the patient is able to move the hip and knee joints; more so on the right side. No motion of the ankles. Can stand with support.

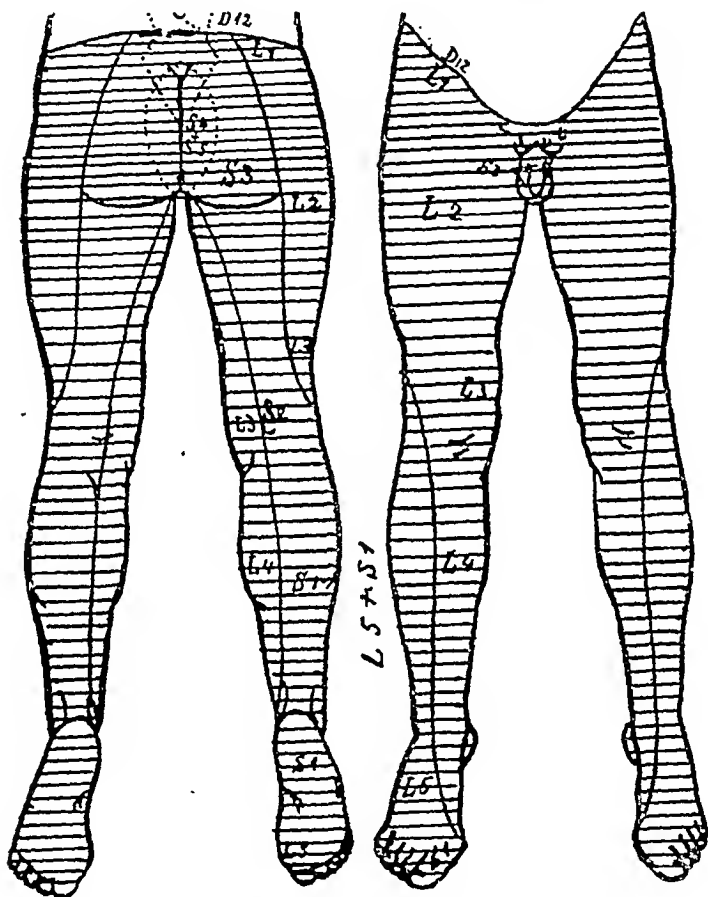


Fig. 3. The largest extent of the sensory disturbances.

Sept. 9. The strength of the legs has increased. Can now walk with support. No active motion of the ankles. The sensory disturbances have decreased further. Since Aug. 28 spontaneous miction. No residual urine. The bowels can now be regulated with enemas only.

The course was complicated by at least two attacks of pyelitis and one of epididymitis, both of which, of course, can be connected with the damage to the bladder which necessitated catheterization.

Examination in Nov. 1945. No pains, paresthesias or cramps. Flaccid paresis both legs below the knees. Sensory disturbances of smaller areas of the distal portions of the feet, and of the perineum. Able to void but must during the miction lean forward and use abdominal pressure.

Bowel action fair. Unable to feel bowel content passing through the anus. Cannot control flatulence. No definite circulatory disturbances. The feet feel cold and clammy.

*Summary.* A male, 54 years of age. Spinal anesthesia with 23 ml. of Ciba's original percaine solution 1:1,500. Fractional doses. Immediately following surgery motor and sensory disturbances corresponding to segments L I—S V. Bladder and rectal difficulties. Slow improvement of the symptoms. After one year and four months smaller sensory disturbances (about the same as in a caudal syndrome) remain, flaccid paralysis below the knees, and a limited bladder lesion. Insufficiency of the rectal sphincter. Can hardly stand or walk without support.

*Case No. 4.* The Surgical Department, Centrallasarettet, Östersund. A woman, 32 years of age. *Cholelithiasis and choledocholithiasis with jaundice.* Cared for in the department Sept. 30—Oct. 15, 1944.

Oct. 3. Cholangiography, choledocholithotomy, drainage of the common bile duct. Spinal anesthesia with 28 ml. percaine solution

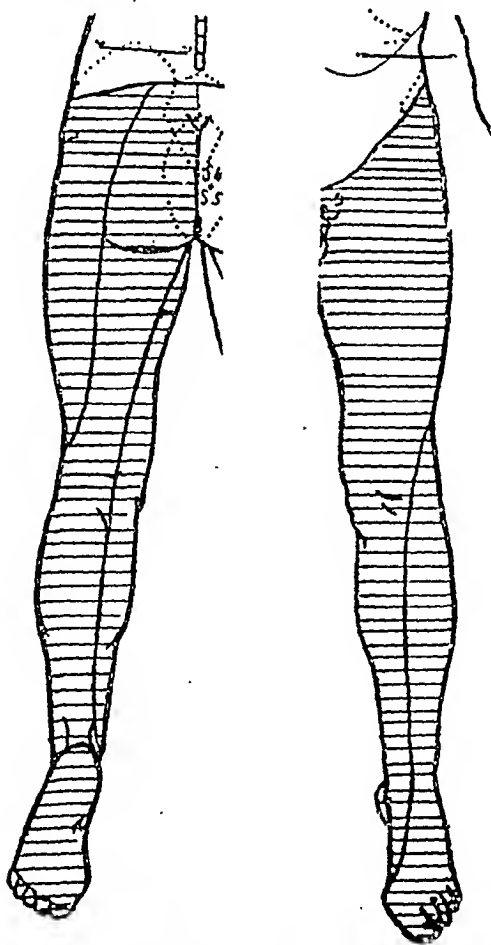


Fig. 4. Maximum distribution of the sensory disturbances.

prepared in the hospital (such in use since 1943). Solution 1:1,500. Fractional doses.

Oct. 5. For the last two days unable to lift the left leg. Oct. 7. Moves the leg somewhat. Can bend the knee. Oct. 15. The strength of the left leg has increased gradually. Walks without support. However, not in stairs.

The patient gives the following supplementary information. While giving the anesthetic severe pain in the left leg. The pain did not disappear after the position of the needle had been changed. Immediately after the operation paresis of the whole left leg. Only after a few weeks was she able to walk in a fairly normal manner. The strength is still (Dec. 2, 1945) markedly decreased in all the muscle groups of the leg, especially the extensors of the big toe. It is hard to run, and she cannot participate in any sports. From the beginning the sensory disturbances involved all the types of sensation from about L I and downwards. Now decreased sensibility (most of temperature, least of touch) in the segments L I—IV and totally lost below that. Since the operation, bowel and bladder functions have been disturbed. The desire to void and defecate is not felt in a normal manner. However, the bladder and the bowel can be emptied spontaneously. On the left foot have appeared indolent, trophic ulcers hard to heal. Trophic disturbances also of the nails of the foot.

*Summary.* A woman, 32 years of age. Spinal anesthesia with 28 ml. of a percaine solution 1:1,500, prepared in the hospital, given in fractional doses. Immediately after surgery disturbances (sensory and motor) of the left leg corresponding at least to the segments L I—S V. Bladder and rectal difficulties. Trophic ulcer left foot. Changes of the nails. Gradual improvement but after more than one year still rather marked residual symptoms.

*Case No. 5.* The Surgical Department, Centrallasarettet, Linköping. A male, 36 years of age. *Chronic cholecystitis*. Cared for in the department Jan. 31—Feb. 23, 1945.

Feb. 3. Cholecystectomy. Spinal anesthesia with 18 ml. of Ciba's original percaine solution 1:1,500. Fractional doses. While the anesthetic was being injected, there were violent pains from the level of the umbilicus down into both feet. At the same time there was a strong flexion of both knees. He could control the left one himself but the right knee had to be straightened by the nurses. Two days after the operation there were pains in the right gluteal region. The whole right lower extremity felt numb. Later no pains. While up the patient could not use the right limb normally. No urinary or rectal difficulties.

April 25. The right lower limb started to swell fourteen days ago. This recurred several times later while the patient was being cared for in the medical department. A sore under the big toe. Paresthesias.

Right leg swollen, warmer than the left, slightly discolored. The sensation of pain is decreased from the upper part of the thigh down to the knee. It is absent below this. The muscle strength is decreased in

the whole of the right lower limb. Under the whole of distal phalanx of the big toe is a sore. Hemorrhage under the nail of the second toe. Atrophy of the muscles of both thigh and leg. April 25. Lumbar puncture. The initial pressure 130 mm. Queckenstedt's sign normal. Ten ml. cerebrospinal fluid withdrawn. Final pressure 90 mm. The fluid is clear and colorless. Nonne's test positive. Pandy's test ++. Heller 1:16.

May 18. Has been up since May 9. After a few days swelling of the right foot with formation of a dark blue blister.

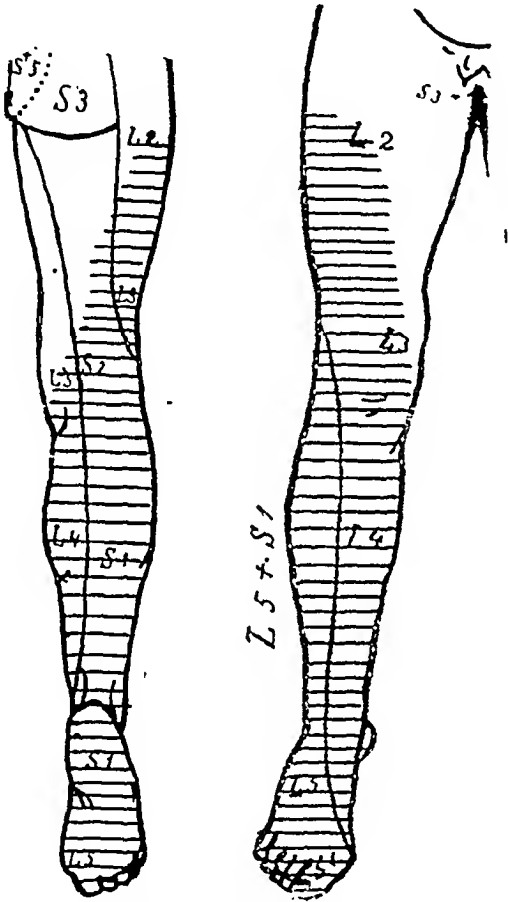


Fig. 5. The distribution of the sensory disturbances.

May 31. Has been up for 14 days. The sores are healed. Feeling better. Walks fairly well. The muscular atrophy remains. The sensory disturbances almost unchanged. June 7. Again a sore under the toe. Condition about the same. July 8. The strength of the dorsi-flexion of the right foot is decreased. The foot is warmer than the left, cyanotic. July 11. More perspiration on the right leg than on the left. The blood pressure in the right leg is 130 and in the left 140 (measured by palpating a. dorsalis pedis).

Aug. 11. The strength of the leg is increased. The weakness of the dorsi-flexion remains. Otherwise the same strength as in the left leg. The sensory disturbances as before. The sore under the big toe remains. Atrophy of the muscles of the thigh and leg.

Aug. 15. Referred to a neurological department. As the admission was delayed, the patient felt free to resume work. Therefore it is most likely that only a mild degree of disability remained.

*Summary.* A male, 36 years of age. Spinal anesthesia using 18 ml. of Ciba's original percaine. Solution 1 : 1,500. Fractional doses. While the anesthetic was being injected, the patient had violent pains from the level of the umbilicus down into both feet. Cramp of the legs. Not later than two days after the surgery, there were symptoms of disturbance (sensory and motor) present, corresponding at least to the segments L II—S V on the right side. No difficulties with the urination or defecation. Paresthesias. Circulatory disturbances in the right leg (swelling, cyanosis, increased pulse pressure). Increased perspiration. Trophic ulcer under the right big toe. Decidedly improved within six months. the symptoms of paralysis disappeared almost completely but the sensory disturbances and the trophic ulcer remained. Able to work.

*Case No. 6.* The Surgical Department, Centrallasarettet, Umeå. A woman, aged 36. *Cholelithiasis.* Cared for in the department July 19—Aug. 3, 1945.

July 24. Cholangiography, exploration of the common bile duct via the cystic duct, cholecystectomy. Spinal anesthesia using 23 ml. percaine solution 1 : 1,500, prepared in the hospital.<sup>1</sup> Fractional doses. No complication. Very good anesthesia. Felt well for the first few days following surgery.

July 28. Sensation of numbness in the back, spreading downwards into the lower limbs. During the next few days, extensive sensory and motor disturbances developed approximately below Th VI. Bladder and rectal difficulties. No pain.

Referred to the medical department. Paralysis of the muscles of the abdomen and lower extremities. Only very slight movements of the ankles. No definite objective disturbance of the sensibility but subjective decrease of the sensation of touch and pain, extending from Th VI to S V.

Aug. 22. Can now void. Oct. 4. The muscle strength of all joints is increasing well. The sensibility is decreased approximately Th VIII—S V. Nov. 16. Marked pareses remain, especially of the muscles of the peroneus and the quadriceps groups. Able to stand with support. The sensibility approximately the same as before. The bladder and rectal functions normal. Bilateral positive Babinsky. Ankle clonus. Discharged upon own request.

<sup>1</sup> Since 1943 similar percaine solutions have been used in about 2,000 cases of spinal anesthesia without producing any such symptoms. Of the 392 ampoules prepared in this series and in use at the time of this operation, about 350 had been used without causing any difficulties. Bacteriological and chemical analysis of the remaining ampoules of this series gave no reason for remarks.

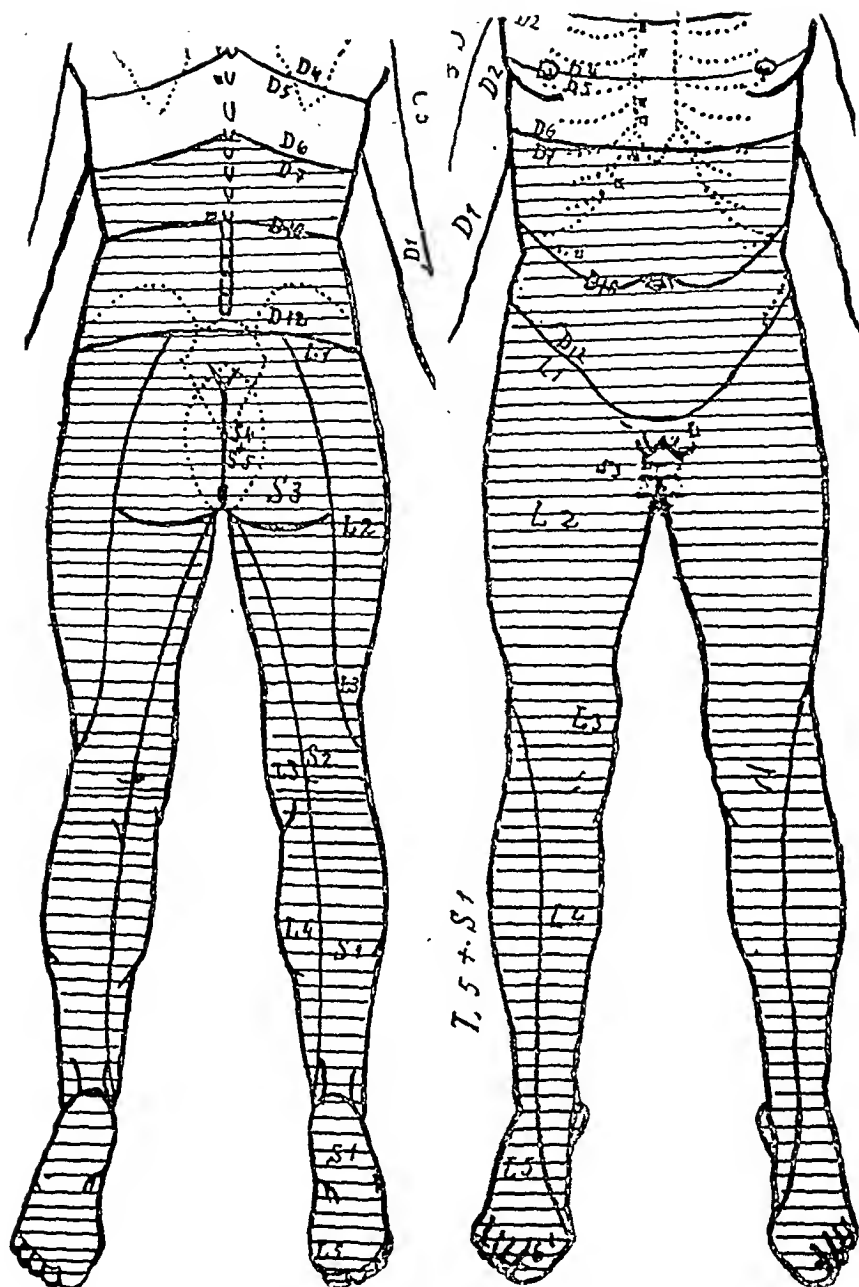


Fig. 6. The distribution of the subjective sensory disturbances.

*Summary.* A woman, age 36. Spinal anesthesia using 23 ml. per-caine solution 1 : 1,500, prepared in the hospital. Fractional doses. Four days after the operation, symptoms started which in a few days developed into marked disturbances (motor and subjective sensory) of the segments Th VI—S V. Transient bladder and rectal difficulties. Within four months definite improvement but remaining marked paralyses and sensory disturbances.



## E. Study of the Postanesthetic Lesions.

### a. Frequency.

The figures vary greatly in the literature, probably because of the different anesthetics used, and also because the doses and the concentrations have varied much. The extremes can be mentioned: GOLDSCHWEND had three cases of paraplegia in 100 cases in which tropacocaine was used while DUJARIER only saw one transient paralysis in 4,000 patients (name of drug not given).

*In the material collected by me, which at least for the year 1945 includes well over 23,000 cases, there are six definite cases in three years. The frequency of these severe damages can therefore, with great probability, be estimated to about 1 : 10,000 cases, or about 0.01 %. Basing the estimate only on the cases of injuries from percaine, the figures would be a little higher. It is sure that we are dealing with the minimum figures. Experience shows that, because they are so rare, the cases are misinterpreted and are not thought of in a causative connection with the spinal anesthesia but rather considered as a spinal cord tumor, disseminated sclerosis, etc.*

*All six cases have been anesthetized with percaine. In four were used Ciba's original ampoules, in two solution prepared in the hospital. In all cases the concentration was 1 : 1,500. Regarding the percaine solution used by us, the reader is referred to the footnote under casuistics.*

### b. Pathogenesis.

Using proper technic, *puncture lesions* can only reach the cauda equina. Experiments on corpses have shown the author that puncture of a root (even far out laterally) with intramedullary injection via the root are hardly mechanically possible. In most cases, it could be possible for a spinal needle to injure one or — after change of position — probably a few roots. Such limited injuries are known to exist but *puncture lesions cannot be a common cause of typical postanesthetic lesions.*

*Hemorrhages due to puncture* must surely be considered. To cause any real damage they must be massive. *Injuries due to hemorrhage are possible but probably not common.* In the many animal experiments related above, they are of no importance. In the relatively few autopsy cases on humans, there are no definite findings of hemorrhage or residual hemorrhages.

*Meningeal reactions* are as a rule very mild but reach in exceptional cases (WEIGELDT's) such proportions that from this cause alone severe nervous symptoms can be explained. In most of the animal experiments and autopsy findings on humans, it is definite that the meningeal reaction is harmless. *This explanation as a cause can thus be accepted only in a few exceptional cases.*

*Sensitivity reactions* can hardly cause such localized injuries as, for instance, necrosis of the spinal cord and must be considered as unlikely. Neither can *trophic disturbances*, due to a prolonged and marked fall of the blood pressure, be considered as the cause (LUNDY, ESSEX and KERNOHAN; BROCK, BELL and DAVISON, et. al.). Prolonged increase of the intradural pressure as well as *osmotic injuries* are very unlikely to be the cause (LUNDY, ESSEX and KERNOHAN).

*The probable cause of the injuries of the spinal cord is a chemotoxic effect* (DAVIS, HAVEN, GIVENS and EMMETT; MACDONALD and WATKINS; PEIRSON and TWOMEY, et. al.). *Animal experiments show that just the anesthetic and not other substances present in the solution is the cause* (FERGUSON, MACDONALD and WATKINS, et. al.). *The effect on the myelon is also proportional to the strength of the anesthetic solution as well as to the injected volume* (LUNDY, ESSEX and KERNOHAN, MACDONALD and WATKINS). *It is always observed that the damage to the myelon is most marked caudally where the concentration of the drug can be considered to have been the highest.* However, it is hard to explain why so few people are affected. *So far, one will have to be satisfied with the supposition that a rare individual sensitivity is present.* In this connection one must think of SEBRECHTS's theory of rachisensitive and rachiresistant people.

### c. The Time for the Appearance of the Symptoms.

In fairly rare cases, *marked and severe pain appears already during the giving of the anesthetic* (BOISSEAU; BROCK, BELL and DAVISON, Cases Nos. IV and V). In all these cases, severe symptoms were observed as soon as the anesthesia had worn off. *As soon as pains appear during the giving of a spinal anesthetic, it must be strongly recommended to discontinue the injection and if possible to postpone the operation.* Should it be impossible to delay the surgery, the injection should be stopped and another type of anesthetic chosen.

*In most cases, the nervous symptoms are present — sometimes, however, not fully developed — as soon as the anesthesia has disappeared. In a marked number of cases (BROCK, BELL and DAVISON; CRITCHLEY; FRANKE; KELMAN, MACLACHLAN; PAUL, Case Nos. V and VI) there exists between the end of the anesthesia and the appearance of the symptoms a short interval of a few days up to one week. In a few cases, one can speak of delayed trouble. In these, the symptoms appear in several weeks or a few months (BRAIN, ELSTAD, WEIGELDT). To these cases belong those (BRAIN's and WEIGELDT's) where vascular changes, respectively leptomeningitis, are very prominent.*

If the theory of a chemo-toxic pathogenesis is retained, it should be expected that the nervous symptoms could be seen as soon as the anesthesia has disappeared. Should the interval be short, one must consider the fact that it must take some time before the injuries have developed (see animal experiments done by KLOSE and VOGT and cited above). For the delayed difficulties the explanation seems easier. In the two autopsy cases which belong to this latter group (BRAIN's and WEIGELDT's) quite some time must have elapsed before the vascular changes, respectively the leptomeningitis, could have reached such an intensity and distribution that injuries to the myelon have developed.

#### d. Type of Symptoms.

*The phenomena of irritation consist of paresthesias, pains and cramps. As a rule the paresthesias are the precursors of the pains. Cramps are rare and belong to the initial stadia. Generally the pains are of short duration. The symptoms of irritation disappear as a rule in quite a short time. In rare cases (BROCK, BELL and DAVISON) anesthesia dolorosa develops (which after about three years necessitated a chordotomy).*

*The phenomena of loss of function concerns touch and mobility. In a few days the sensory disturbances reach their maximal distribution. This varies much but will at times reach that of transverse myelitis. Not rarely the anesthesia is dissociated. As a rule pareses and paralyzes develop speedily. The involvement of the muscle groups may reach the degree of paraplegia. The condition of the reflexes depends on the sensory and motility injuries. As a rule there is in the beginning a state of flaccidity which after quite a long time can be changed into one of spastic symptoms. Bladder*

*and rectal difficulties* are serious. An early period of urinary retention is usually changed into one of incontinence. Prolapse of the rectum may develop. The function of the bladder and the rectum seems unusually susceptible to injuries following spinal anesthesia. At times they alone are involved but oftener they are combined with a caudal syndrome, symptoms from one leg or a complete paraplegia. Disturbances of the *sexual functions* can be caused by pains or sensory disturbances. It is also possible that centers in the spinal cord have been damaged.

Rarely are seen disturbances of the *circulation* or the *secretion* of sweat. *Decubital ulcers* are quite common. Not too rarely *trophic ulcers* of the feet are mentioned (FORGUE and BASSET; GOVSEJEV and ROSSIN; Cases Nos. IV and V). As usual the nature of these is quite unclear.

### e. Pathology.

*The changes behind the symptoms belong to the spinal cord and its membranes while nerve roots and spinal ganglia are involved not at all or very little.* The injuries of the myelon vary much as to intensity and distribution. Caudally they are always at a maximum. From transient disturbances one reaches via chromolysis, achromatosis, injuries of the axis-cylinders and processes of demyelination clear over to real — although quite limited — necroses. The findings of secondary degenerations are common, as are also certain glial and meningeal reactions. The various pathological findings correspond well to the transience or persistence of the symptoms, their varying distribution, protean nature, irregular admixture, etc.

### f. Prognosis.

*In a small number of cases, all evidences of the disease disappear in a short while* (ASHWORTH; BROCK, BELL and DAVISON; CRITCHLEY; MÜNCHMEYER; SCHAUPPISSER, et al.), at times after a few days but usually after weeks or months. Usually *most cases* show an improvement after a long time (months or years) but *the final result is usually a defective healing process with more or less marked invalidism.*

*A small number of cases die, usually due to the bladder impairment.* Such deaths have been reported by, among others, BRAIN; BROCK, BELL and DAVISON; CRITCHLEY; NONNE and DEMME; WEIGELDT, et al. In a few cases it seems that infections, starting

in the decubital ulcers, have contributed. In exceptional cases other causes of death are mentioned, such as respiratory paralysis (ELSTAD) and pneumonia (FRANKE).

### g. Treatment.

At present there exists no prophylaxis against injuries which may follow spinal anesthesia. We cannot judge what patients will suffer from injuries of the myelon following such anesthesia. As has been mentioned already, however, one piece of advice can be given — discontinue the giving of a spinal anesthetic which causes pain already at the time of the injection.

Have the symptoms already manifested themselves, only symptomatic treatment can be considered. Against pain, chloroform is indicated only in desperate cases. The urinary tract and the bowels require their special care. Care must be taken to prevent bed sores. Physical therapy (baths, massage, electricity, etc.) is only of a limited real, but perhaps of a greater psychic, value.

## 5. Conclusions.

*Thus, from the use of any of the present-day spinal anesthetics there may follow serious nervous symptoms which depend upon (probable chemo-toxic) injuries of the spinal cord or its membranes. In the large material, collected by the author through questionnaires, the risk can be estimated to be at least 0.01 % or 1 : 10,000.*

According to the opinion of the author, the advantages of a well given spinal anesthesia are so great that they easily counterbalance the small risk for postanesthetic injuries. *However, according to the opinion of the author the indications for spinal anesthesia should be made more rigid. In those cases in which, without any essential inconveniences or risks, another and less harmful method of anesthesia can be substituted for spinal anesthesia, without doubt this should be done.*

### Summary.

A short review is given of the common spinal anesthetics.

After injection into animals of tropacocaine, novocaine, stovaine or alypin transient or permanent changes can take place

in the spinal cord or its membranes. If permanent, there are also nervous symptoms. Nerve roots and spinal ganglia are not involved or are injured only slightly. — After the use in humans principally the same changes and symptoms can occur from tropacocaine, novocaine preparations, pantocaine (decicaine), tutocaine, stovaine and percaine. — The author's own material is based upon a questionnaire and includes more than 23,000 cases per year. During the years between 1943 and 1945, there were six definite cases of severe postanesthetic injuries. Thus the frequency can be estimated a least about 0.01 % or about 1 : 10,000.

Most likely the injuries are produced by a chemo-toxic effect of the anesthetics upon the spinal cord. Often the symptoms start at once. In a smaller number of cases, there is an interval of a few days or weeks, yes, even months. — Phenomena of irritation (paresthesias, pains, cramps), of loss of function (sensory disturbances, pareses, paralyses, bladder and rectal difficulties), sexual symptoms, circulatory disturbances, changes in the secretion of sweat, and so called trophic ulcers are present. — A short discussion of the pathology is given. — The prognosis is poor. In most cases there is a defective healing with accompanying invalidism. A few patients die (mainly due to infections of the urinary system) while some in a short time return to complete health. — At present prophylaxis is not possible. The treatment must be mainly symptomatic. — The advantages of spinal anesthesia are so great that this type of anesthesia should be retained. The small risk of postanesthetic injuries cautions nevertheless to more rigid indications for spinal anesthesia.

### Zusammenfassung.

Kurze Übersicht der gewöhnlichen Spinalanästhesiemittel. — Nach Einspritzung an Tieren von Tropakokain, Novocain, Stovain oder Alypin können vorübergehende oder dauernde Veränderungen des Rückenmarks und seiner Häute auftreten; im letzteren Falle liegen auch Nervensymptome vor. Wurzeln und Spinalganglien bleiben frei oder werden nur unbedeutend beeinflusst. — Nach Verwendung von Tropakokain, Novocainpräparaten, Pantocain (Decicain), Tutocain, Stovain und Percain können beim Menschen im Prinzip die gleichen Veränderungen und Symptome vorkommen. — Ein eigenes Material fusst auf einer Rundfrage und umfasst über 23,000 Fälle pro Jahr. In den drei Jahren 1943—

1945 kamen sechs sichere Fälle von schweren postanästhetischen Schädigungen vor, so dass die Häufigkeit auf mindestens 0.01 % oder etwa 1 : 10,000 zu setzen ist. — Die Schädigungen dürften durch chemischtoxische Beeinflussung des Rückenmarks durch das Anästhesiemittel entstehen. Die Symptome setzen zumeist sofort ein. In einer geringeren Zahl von Fällen kam ein »freies Intervall« von Tagen oder Wochen, ja sogar Monaten, vor. — Reizerscheinungen (Parästhesien, Schmerzen, Krämpfe), Ausfallssymptome (Sensibilitätsstörungen, Paresen, Paralysen, Blasen- und Mastdarmstörungen), sexuelle Symptome, Kreislaufstörungen, Veränderungen der Schweissabsonderung und sog. trophische Geschwüre können vorkommen. — Kurze Darstellung der pathologischen Anatomie. — Die Prognose ist keine gute. In der Mehrzahl der Fälle ergibt sich eine Defektheilung mit einer gewissen Invalidität. Einige wenige Fälle führen zum Tode (hauptsächlich an Harnwegsinfektionen), und einige erlangen in kurzer Zeit eine Restitutio ad integrum. — Eine Prophylaxe ist z. Z. nicht möglich. Die Behandlung muss hauptsächlich symptomatischer Natur sein.

Die Vorteile, die die Spinalanästhesie bietet, sind so gross dass diese Betäubungsmethode beizubehalten ist. Die, freilich geringe, Gefahr schwerer postanästhetischer Schädigungen mahnt jedoch zur Schärfung der Indikationen für die Spinalanästhesie.

### Résumé.

Revue succincte des produits employés communément pour la rachianesthésie. — Après l'injection de tropacocaïne, de novocaïne, de stovaïne ou d'alypine à des animaux on peut voir survenir des lésions passagères ou persistantes de la moelle épinière et de ses enveloppes; dans le second cas on constate aussi des symptômes nerveux. Les racines et les ganglions spinaux restent indemnes ou ne sont influencés que de façon insignifiante. — Après la tropacocaïne, les préparations de novocaïne, la pantoocaïne (décicaïne), la tutocaïne, la stovaïne et la percaïne les mêmes lésions et symptômes peuvent apparaître en principe chez l'homme. — Le matériel personnel à l'auteur est fourni par une enquête et comprend plus de 23,000 cas par an. Pour les trois années de 1943 à 1945 on a trouvé six cas certains de lésions post-anesthésiques graves, de sorte que leur fréquence peut être estimée à environ 0.01 % au minimum, ou bien à un cas sur 10,000. — Les

lésions sont dues sans doute à une action chimique, toxique, des anesthésiques sur la moelle. Le plus souvent les symptômes apparaissent immédiatement. Dans une minorité de cas il y a un «intervalle libre», de jours ou de semaines, voire de mois. — Des phénomènes d'irritation (paresthésies, douleurs, crampes), des symptômes de déficit (troubles de la sensibilité, parèses, paralysies, dommages à la vessie et au rectum), des symptômes sexuels des troubles circulatoires, des modifications de la sécrétion sudorale, et ce qu'on appelle des ulcères trophiques peuvent survenir. — Bref exposé de l'anatomie pathologique. — Le pronostic est sombre. Dans la plupart des cas la guérison est déficitaire, et comporte une certaine invalidité. Peu de cas se terminent par la mort (le plus souvent par infection des voies urinaires) et quelques uns aboutissent en peu de temps à une restitutio ad integrum. — Aucune prophylaxie n'est possible actuellement. Le traitement reste principalement symptomatique.

Les avantages de la rachianesthésie sont si grands que la méthode doit être conservée. Le faible risque de dommages post-anesthésiques sévères incite cependant à rendre plus rigoureuses ses indications.

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(Surgeon-in chief: O. KAPEL, M. D.).

## **A Lenient Method for Reposition of Fractures and Dislocations of the Vertebral Column.**

By

O. KAPEL.

Without in any way entering into the question about indications for, or the adequacy in general of, measures aimed at reposition of dislocations and fractures of the vertebral column, associated with complete paralysis, pareses or more or less pronounced neurological symptoms, mention will here be made of a very easy method of reposition which, in my judgement, has proved more effective than other methods previously described, and which even is far more lenient than the methods given, for instance, by BÖHLER, DAVIS, WATSON-JONES.

The reposition is carried out as follows. After the diagnosis of fracture or dislocation is made, and after the injury has been found roentgenographically to be of such a character that it would be desirable to reduce it, the patient is cautiously placed on his back on the operating table. This — as presumably every operating table nowadays — is built so that the head and foot ends somehow can be lowered mechanically. In our department we use the "Kifa" tables, on which all the manipulations are performed at the head end, by the anesthetist, which is one of the very great advantages of this table. The middle part of the table is manipulated by a simple turn of a handle (for operations on the bile ducts and kidneys).

When the patient is placed on the table (Fig. 1—3), this is turned cautiously and quite slowly as wanted. If desirable, an assistant or nurse may hold the legs of the patient, while another nurse holds his arms; any form of traction is not necessary. I have

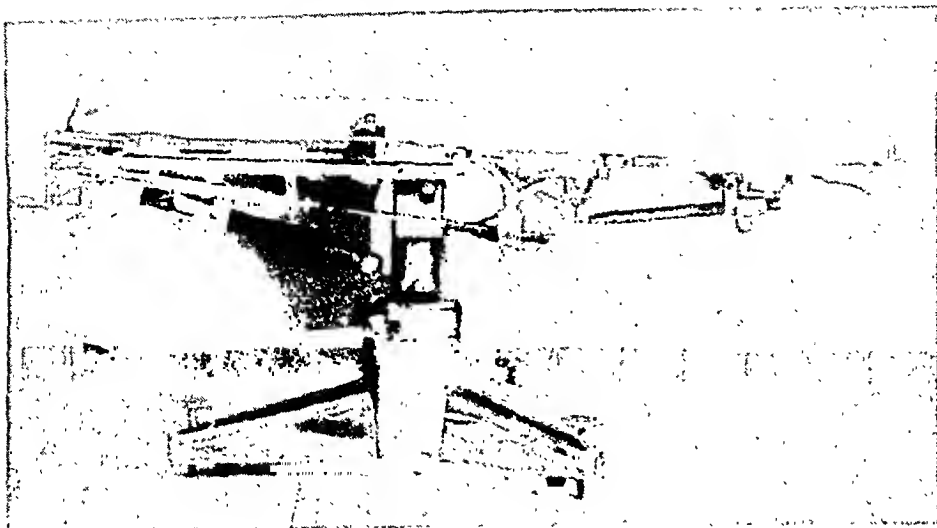


Fig. 1.

placed myself "as patient" on the table under the manipulation, and I have become convinced that the traction exerted in this way is extraordinarily powerful. When the "extension" is half or three-quarter completed, by means of a transportable roentgen apparatus the surgeon can control whether the reposition has taken place or whether additional extension is required. If necessary, the table may be adjusted to maximal hyperextension. In one of our cases (Case Record 2) the patient stated herself that "now the reposition took place". In our three cases we let the patient remain in full extension for about 5 minutes in order to ensure the position — but I do not know whether this is necessary. When the extension is complete a new roentgenogram is taken. In one of our cases we had a little difficulty in obtaining sufficiently good pictures by means of the transportable X-ray apparatus. In this case the chief roentgenologist (Dr. DE FINE LICHT) as "uninterested" objective observer has touched up the outlines of the vertebrae in the X-ray film.

In none of our cases has it been necessary to employ universal or local anesthesia. One patient (Case 3) had transitory nausea during this procedure; otherwise the reposition has been free from any discomfort.

### Case Histories.

*Case 1.* Male, 40 years old, injury due to a fall when the patient landed on both feet. Paralysis of both lower extremities. Roentgeno-

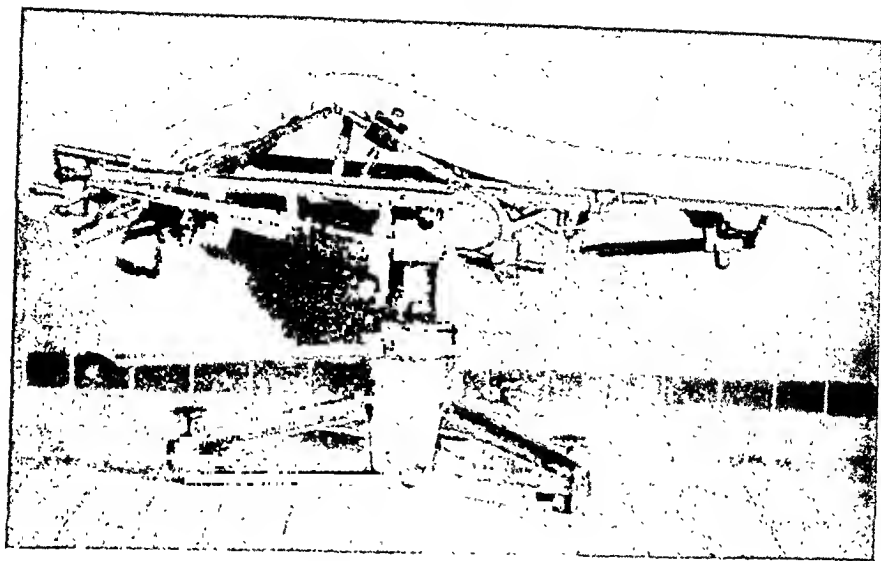


Fig. 2.

graphy: Fracture of the 12' thoracic vertebra. This vertebra is distinctly wedge-shaped (Fig. 4). Reposition as described above. Roentgenography after the reposition (Fig. 5).

After this, the patient is cautiously transferred to his bed, in reclusion. No immediate improvement of the paralysis; but during the following 6 months there is a considerable improvement, so that the patient is able to walk with the support of a cane.

*Case 2. Female, 22 years old*, a trapez artiste in a circus. During the performance of her work she falls to the ground — from a height of 10 m. — and suffers a compression fracture of the 6' dorsal vertebral and complete dislocation between the 9' and 10' dorsal vertebrae (Fig. 6). Complete transversal paralysis. After the diagnosis is made, reposition as above. During this procedure the patient states that she felt a jerk as if something slipped into place again. Roentgenography after the reposition (Fig. 7). Placed in bed with support under the vertebral column, elevated head end, and GLISSON's capsule sling for fixation. There was no improvement of the transversal paralysis, and the patient died with sepsis, 2 $\frac{1}{2}$  months after the admission.

*Case 3. Female, 20 years old*. Similar fracture as in Case 1. Same surgical procedure. Same result. In this case, however, there was no paresis or peripheral nerve symptoms. After the usual treatment adopted in this department, however, with early massage and remedial gymnastics, the patient was discharged, feeling perfectly well, without any deformity of the vertebral column, two months after admission.

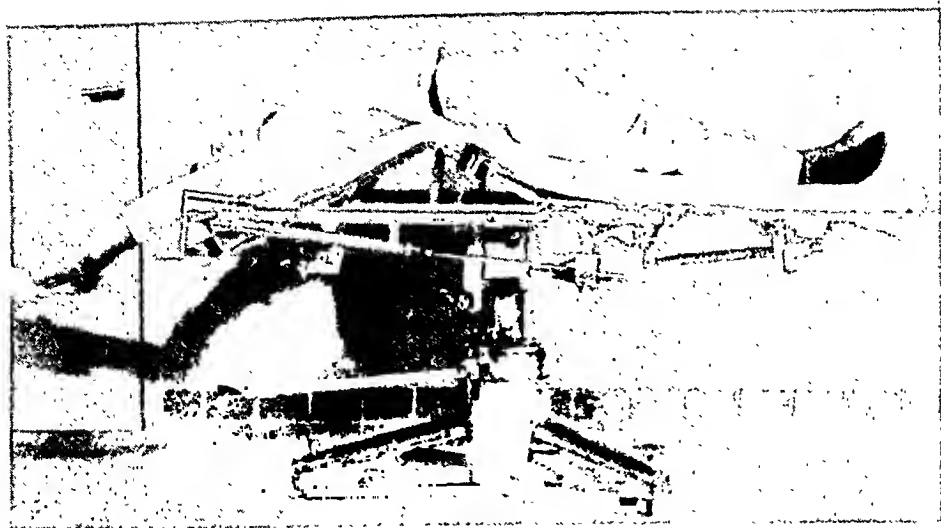


Fig. 3.

These three cases illustrate very well the value of the method of reposition itself. In Case 2 the condition of the patient was hopeless. During the first part of her stay in the hospital she had a slight attack of respiratory paralysis, for which she was given inhalation of oxygen for several days.

In Case 1 the paresis was hardly induced by the compression of the vertebral column but, perhaps, more likely by a hematoma, which possibly should have been evacuated by laminectomy. Whether this was the case will have to be left an open question — likewise whether his paralysis might have been abolished more rapidly or more completely by such a measure.

In his book, WATSON-JONES mentions and depicts a similar principle as here presented, but the method described is far from as lenient and easy to carry through as the one here described and employed.

### Summary.

Description is given of 3 cases of reposition of dislocations and compression fractures respectively in the lumbar and thoracic sections of the vertebral column by placing the patient on "Kifa" operating table in bile-kidney reclinatation.

### Zusammenfassung.

3 Fälle von Verrenkung und Fraktur der Wirbelsäule reponiert durch Verwendung des "Kifa" Operationstisches.

**Résumé.**

On vient de décrire 3 cas de reposition de dislocations et fractures de compression respectivement dans les sections lombaires et thoracales de la colonne vertébrale en plaçant le malade sur une table à opérations "Kifa" en bile-rein-inclinaison.

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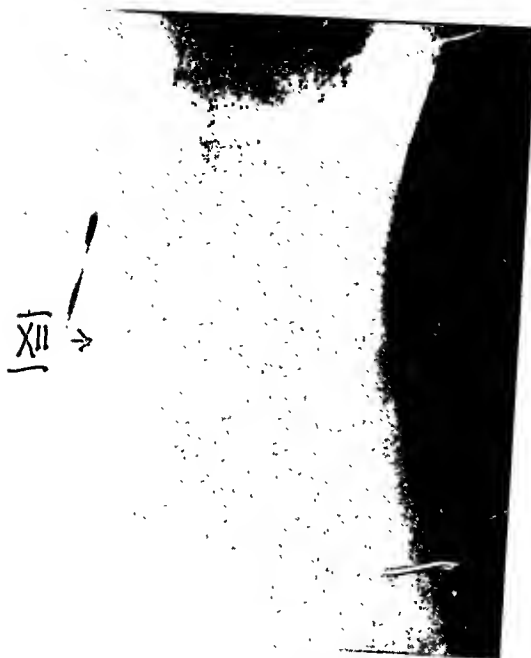


Fig. 4.

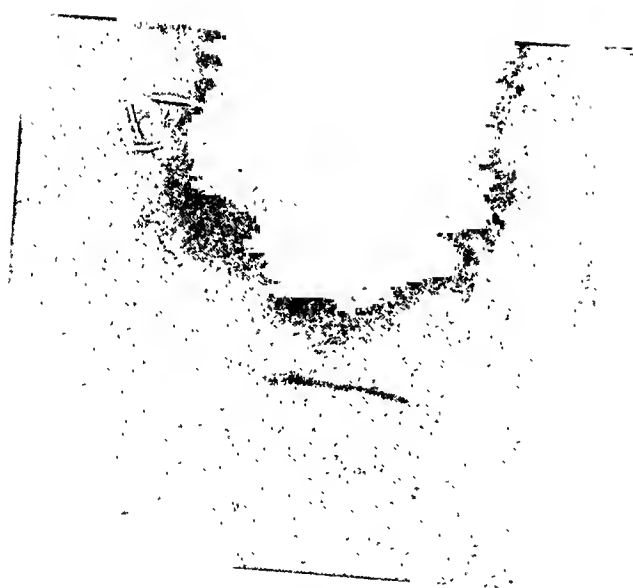


Fig. 5.

KAPEL: Reposition of Fractures.





Fig. 6.



Fig. 7.

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## An Easily Adjustable Distraction Apparatus.

By

O. KAPEL.

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For reposition, among others, of the perilunar dorsal dislocation of the wrist, BÖHLER, in the first edition of his work on fractures (1929), recommended his screw-traction apparatus, which can be employed also for the treatment of other injuries to the upper extremity. Even at the appearance of a first edition of BÖHLER's work it seemed to me that this apparatus was somewhat impractical — at any rate for the above-mentioned special use. In the first place, the apparatus is large, thus taking up a good deal of space; in the next place, the drilling through the metacarpal bones requires a rather large nail, of about the same size as the Steinmann nail. Finally, while the traction obtained with this apparatus only to a certain degree can be regulated, it still will be rather difficult to adjust properly in very obese patients, as it gives no quite firm counter traction against a yielding chest wall.

For the above-mentioned use — that is, for reposition under bloody baring of the bone — as early as in 1932 I constructed an apparatus which, in my opinion, offers several advantages over that of BÖHLER. I have called it a distraction apparatus and I have used it as such on several occasions. But I wish to emphasize at once that with the apparatus demonstrated below I by no means claim to have constructed a distraction apparatus as is now available in several forms, including, among other features, a combination of distraction and rotation of one or both fragments in fractures in poor position.

It was my aim merely to have at my disposal an apparatus capable of reposition, by traction, of neglected and late recog-

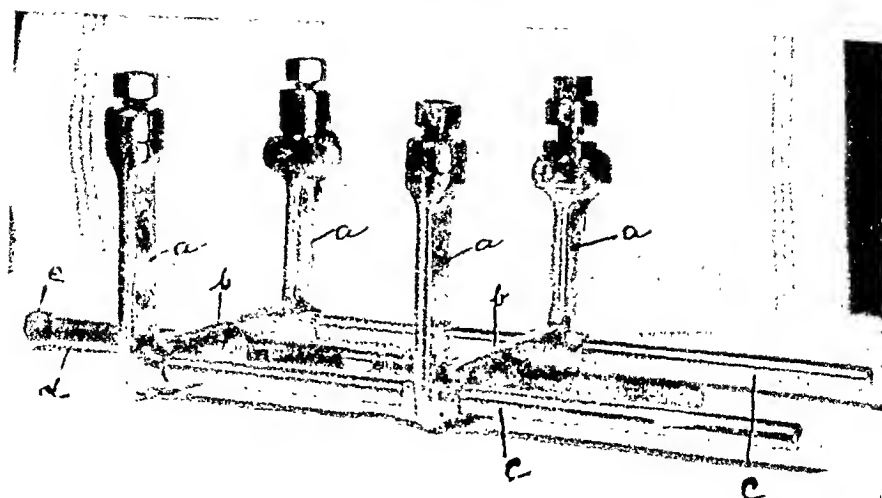


Fig. 1.

nized dislocation of carpal bones, also combined with fractures. As mentioned, this apparatus was completed in 1932, but nearly 10 years had to pass before the injury for which it was constructed originally came under my treatment — illustrating perhaps, how rare this injury is, but perhaps also indicating how often it is overlooked. It was soon found, however, that the apparatus could be employed for other conditions besides the one for which it originally was intended — and some of these will be mentioned briefly below, together with certain other cases in which it has proved unserviceable.

The distraction apparatus itself is shown in Fig. 1, in about half its natural size. It consists of 4 vertical metal rods (a) mutually connected by a horizontal, perforated, transversal bar (b) in the middle of which is a hole provided with a screw thread. Perpendicularly on this cross-bar there are two parallel round rods (c), each carrying the perpendicular stands. The latter (c) are movable, however, by means of the screw-rod (d). The movement is effectuated by means of a wrench that is adjusted at the cap (e).

Prior to the application of the apparatus, the ordinary, so-called Kirschner wires are drilled into place, proximally and distally to the fracture or the site of the dislocation. It is important to see that these Kirschner wires are placed parallelly. Now the apparatus is placed in such a position that the wires rest in furrows in the upper or lower part of the vertical rods

(depending on the best placing of the apparatus). After fixation of the wires at (a) by means of the wrench (Fig. 2), they are *tightened* with the wrench by means of a special sliding mechanism — as is also evident from Fig. 2 (b). Then, by turning the screw



Fig. 2.

(c) on the cap (Fig. 1), the fragments are pulled apart by the extraordinarily strong traction exerted through the tightened wires.

For wrench I have used the Kirschner hoop provided with an extra key attached to the end.

The entire administration of the apparatus after the wires have been drilled in takes less than 3 min. Possibly full distraction is not exerted at once. After a couple of minutes the posi-

tion of the fragments is controlled by means of an ambulatory X-ray apparatus — and the patient is allowed to move about in the ward and to lie down with the apparatus attached when the position of the fragments has been ascertained to be satisfactory. Later on, the control roentgenography may be repeated.

As is evident from the description given by BÖHLER, his apparatus is reckoned to permit operative measures. The apparatus described above offers the positive advantage over BÖHLER's apparatus that it can be sterilized by ordinary autoclaving together with the other instruments employed in case of operation.

Even though it was not the first time this apparatus was used, it will be appropriate first to mention a case of a neglected perilunar dislocation-fracture of the wrist neglected in the sense that, because of other very severe injuries and the general condition of the patient, the serious character of the injury to the wrist was not realized till 3 weeks after admission (Case 1).

*Case 1. Male, 27 years old, glazier, of vigorous build.*

On  $\frac{8}{5}$  43 he fell down to the ground from the third floor, landing on both feet. He suffered a concussion of the brain, besides bilateral comminute complicated fractures of the calcaneus. These fractures were taken under treatment at once, no attempt being made at any reposition, as both calcanei were completely crushed into small fragments. In the left lower extremity a severe phlegmon developed up along the leg, necessitating several incisions. A regular sepsis developed, but the patient got over it. At this point of time he complained of persistent pain in the left wrist. Roentgenography showed a typical perilunar dislocation-fracture (Fig. 3).

On  $\frac{2}{7}$  43: Application of the distraction apparatus and bloody reposition. Fig. 4 shows how successful the distraction was. After its application for 10 days, the apparatus was removed, and the hand was placed in a plaster cast. The patient was last seen in 1945. The mobility in the wrist-joint is somewhat limited.

Mention is now to be made of a few other cases in which this apparatus proved highly serviceable in the treatment of various fractures.

*Case 2. Female, 17 years old, fracture of the proximal end of the tibia. Repeated attempts at reposition turned out unsuccessful. After application of the distraction apparatus the fracture was found to remain in a very good position. The apparatus was not removed till callus formation was demonstrated. After this, healing of the fracture in ideal position (Fig. 5 and 6).*

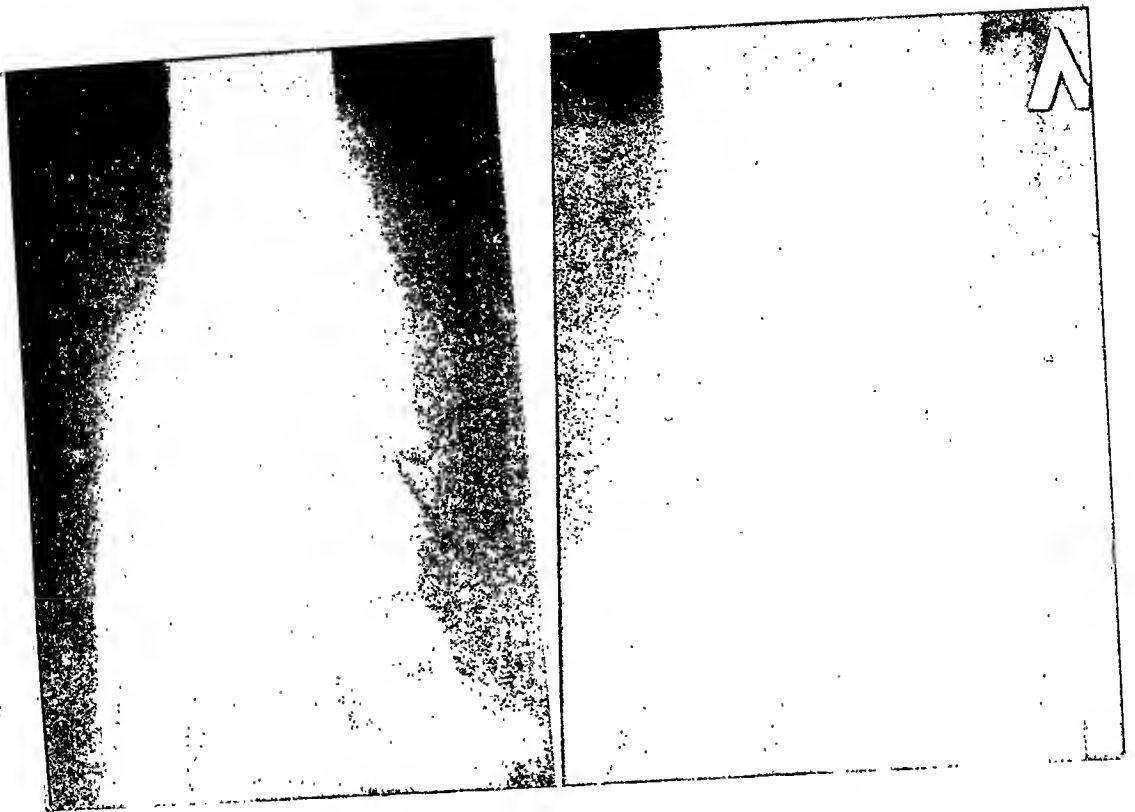


Fig. 3.

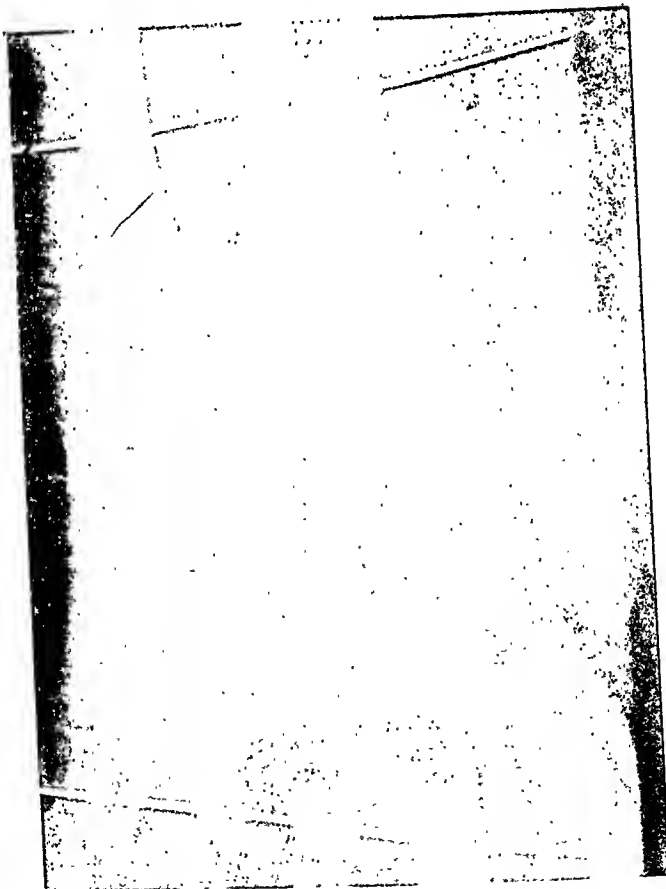


Fig. 4.

KAPEL: Easily Adjustable Distraction Apparatus.

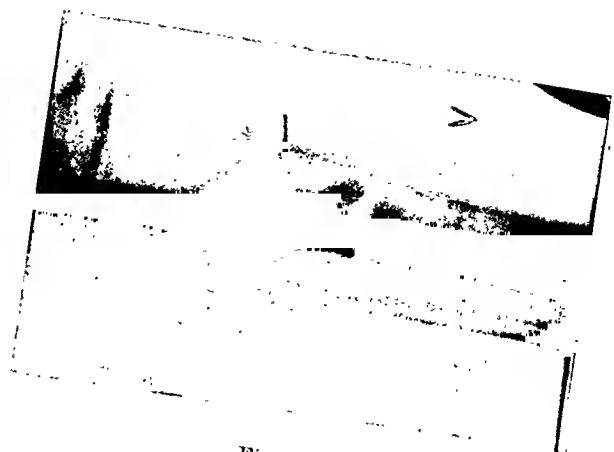


Fig. 5.

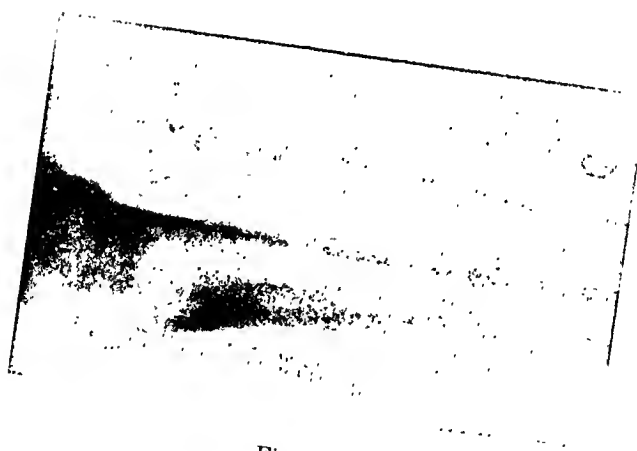


Fig. 6.

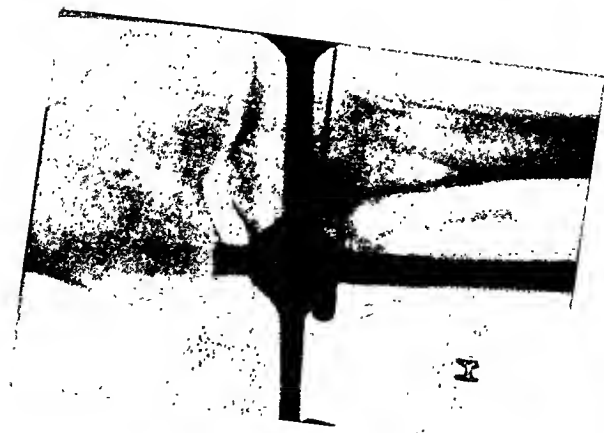


Fig. 7.

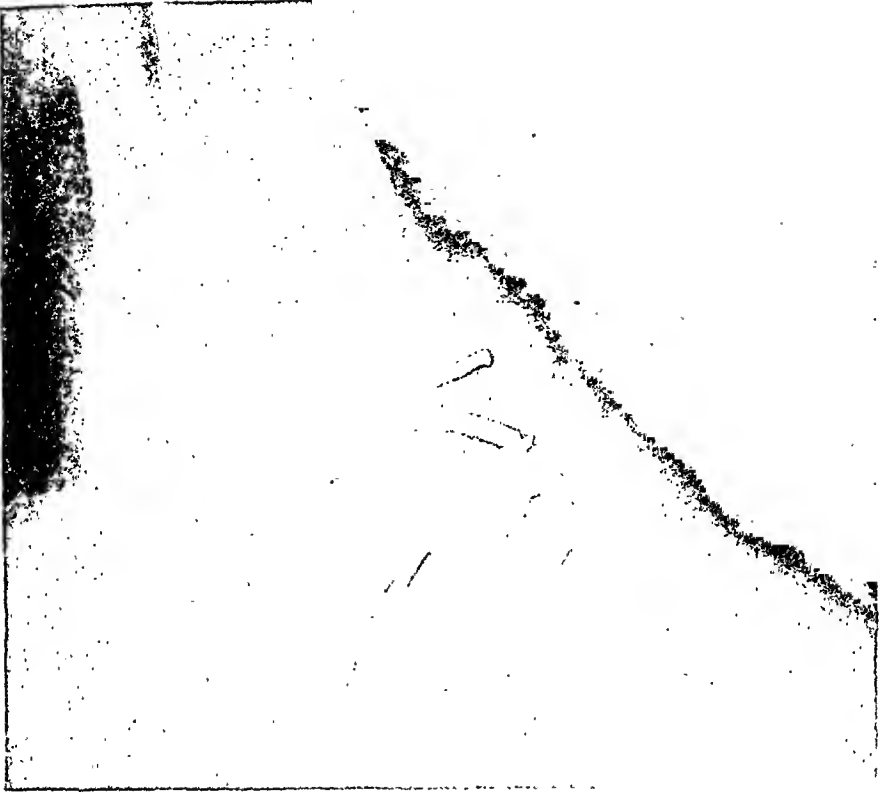


Fig. 9.



Fig. 10.

KAPEL: Easily Adjustable Distraction Apparatus.



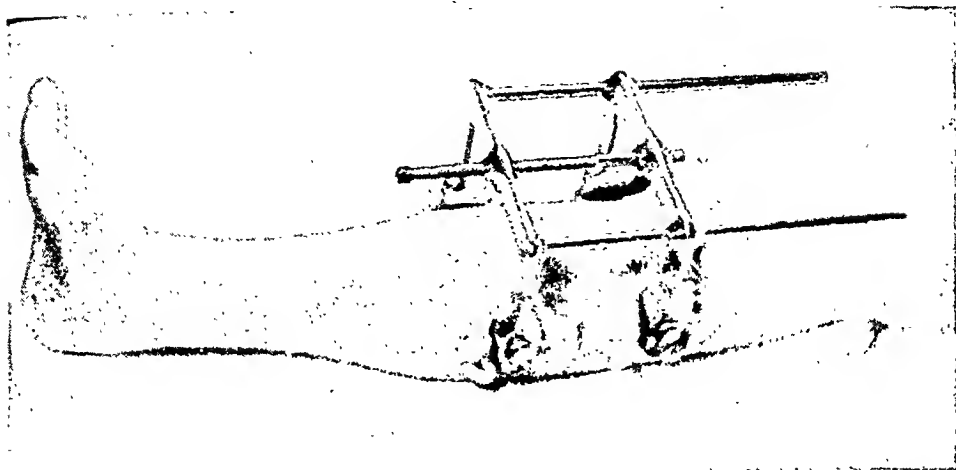


Fig. 8.

*Case 3. Male, 83 years old.* This patient presented a similar fracture as the preceding patient (Case 2). The fragments were fixed at once with the apparatus (Fig. 7 and 8) and could thus be kept in situ till the callus was formed. Movements in the knee, hip and ankle could be made throughout the period of treatment. (The patient was later admitted to this department with a fracture of the neck of the femur. Then the tibial fracture was completely symptom-free.)

*Case 4. Male, 37 years old.* Fracture of the scaphoid bone of the tarsus, with dislocation of the fragment.

On  $\frac{8}{8}$  40 he fell with his bicycle and suffered the fracture mentioned (besides fracture of the radius). The wires were introduced through the astragalus (proximally) and cuneiform bones (distally). Control roentgenography during the operation showed good reposition (Figs. 9, 10 and 10 a). The apparatus was removed 8 weeks later, and at that time the position was still good. The patient was then allowed to get up, with plaster cast for walking. Reexamination, December 1945, showed an ideal position of the healed fracture, without any symptoms whatever.

*Case 5. Female, 18 years old.* Fracture of the scaphoid bone of the tarsus, with dislocation of the fragment.

On  $\frac{2}{6}$  44 the patient suffered a similar injury as No. 4. The distraction apparatus was applied, and during the distraction the dislocated fragment could readily be pushed into its proper position by percutaneous manipulation. The apparatus was removed 6 weeks later, and the patient was allowed to get up 10 days after.

In a couple of cases of very loose fracture of the leg the apparatus was found unsuitable, as the distal fragment could not be kept in situ. This would require an additional vertical rod

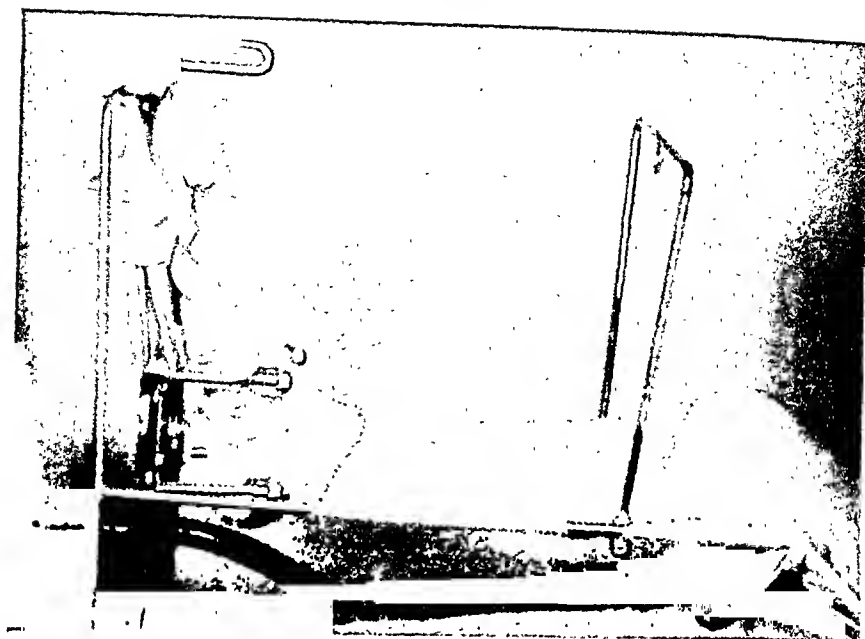


Fig. 10 a.

on the apparatus. It was not my intension, however, to make any universal instrument but an apparatus as simple as possible in its employment. Subsequently, however, this apparatus was found to be serviceable also in a case of a very severe, completely loose, doubly complicated fracture of the leg — merely together with ordinary wire extension as generally given in this department. The case history of this patient is briefly as follows:

*Case 6. Male, 21 years old. Admitted on 23/12 44.*

The patient was a member of the resistance movement. While blowing up a factory, operated by the enemy, he was struck by a tumbling wall. No further details available. He had suffered a completely loose, splintered fracture of the lower third of the left leg (Fig. 11) besides 2 severe injuries to the soft parts. Application of wire extension alone proved ineffective. With the two large contaminated injuries it seemed inadvisable to apply a plaster cast even with fenestra. Therefore, as a supplement, the distraction apparatus was applied, and this did not only keep the fragments in position (Fig. 12) but allowed also open treatment of the wounds (Fig. 13), which healed slowly under this treatment. Also the fracture healed, so that in December 1945 the patient was able to move about with the aid of a cane; and soon he will be able to resume work.



Fig. 13.

In this case the distraction apparatus meant an invaluable help in the retention of the fragments and also in the treatment of the severe injuries to the soft parts — as are seen plainly in Fig. 13. It seems to me doubtful whether the left leg of this patient might have been saved without the treatment afforded by this apparatus.

It will suffice here to mention these 6 cases in which the convenient and easily managed apparatus has proved to be the only way possible for reposition and proper retention of markedly dislocated fragments. After the case records above it will hardly be necessary to mention that the apparatus is left in situ for some length of time, and that on this account we have two such apparatuses at our disposal in this department. This has proved quite sufficient, as I do not remember any point of time when both of them were in use simultaneously.

In conclusion, it will be appropriate emphatically to point out the advantages of the apparatus:

It is easy to manage;

It is easy to sterilize;

*It can be applied quickly;*

*It exerts a powerful distraction;*

*The wires employed for the distraction give only slight injuries to the bones; and*

*Open injuries to the soft parts can be inspected and treated while the apparatus is in use.*

P. S.

The distraction apparatus is made by one of the mechanics of the hospital. Price: ca. 200 Danish Kroner.

### Summary.

An easily adjustable distraction apparatus for reposition of certain fractures and dislocations is described; 6 cases are mentioned as illustrations.

### Zusammenfassung.

Ein einfaches Distraktionsapparat wird beschrieben. Erwähnung von 6 Fällen.

### Résumé.

Un appareil facile à régler pour la reposition de certaines fractures et dislocations vient d'être décrit. Comme illustration 6 cas sont mentionnés.

From the Surgical Department, Allmänna Sjukhuset, Malmö.  
(Chief: OTTO LÖFBERG, M. D.)

## A Contribution to the Operative Treatment (Resection) of Cancer of the Rectum.

By

FREDRIK KOCH.

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The rather high frequency of cancer of the rectum makes its treatment one of the central problems of modern surgery, as is seen from the number of reports published during the last few years by both German and Anglo-American authors: notably LOCKHART-MUMMERY, RANKIN, OPPOLZER and NITSCHE, FINSTERER, SCHMIENCKE, MAYO, COLLIER and RANSOM: Various methods of operation have been recommended. Inspired by GULEKE and GOETZE the Germans attack the cancer chiefly by the perineal route. The combined method seems to be preferred by English and American surgeons. A study of the operation reports from the Swedish hospitals shows the combined operation in stages to be the most practised, and in the choice between amputation and resection, most Swedish surgeons prefer the former method.

In the surgical Clinic of Malmö, however, the normal procedure during the last 30 years has been to operate in one stage and to preserve the anal sphincters, as far as possible. We believe it to be of interest to set down the large amount of information and experience which we have acquired of this method of operation.

The limits of the rectum have various definitions in surgical literature; as a rule the border between the colon and the rectum is said to be on the level of the third sacral vertebra. But sometimes the colon pelvicum too is included in the rectum, the border being drawn at the promontory. As to the lower borders, some casuists include even the anal cancers. The anatomical borders of the rectum have decided the delimitation of this material; the oral border towards the colon pelvinum has been drawn at the peritoneal reflection, and the caudal border at the

anus. Carcinomata in the colon pelvinum situated above the reflection are not included; they have been reported upon in an earlier paper of the Clinic (Koch) on the cancer of the colon. Nor are the anal carcinomata included. *The present material consists of the cases of rectal cancer that were diagnosed and treated at the Surgical Clinic of Malmö during the years 1918—1943, in all 276 cases.*

The incidence of cases during the period in question is shown in fig. 1.

Number  
of cases

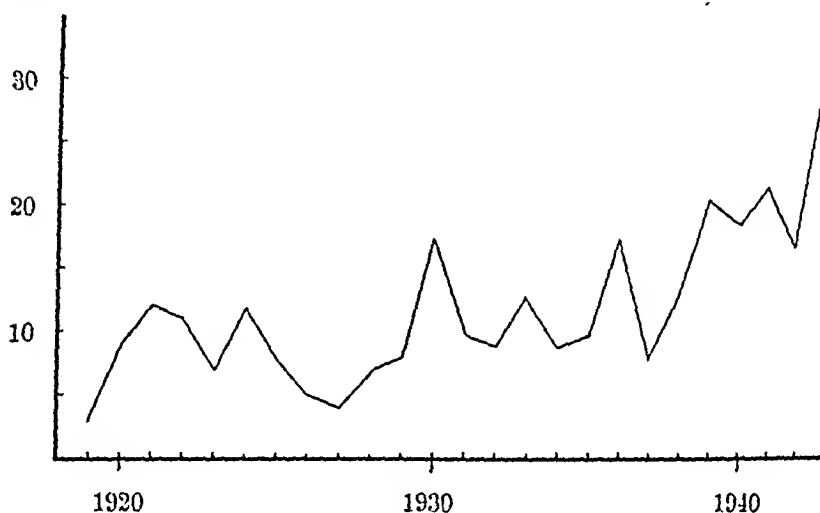


Fig. 1.

The table shows a continuous increase in the annual number of cases. But the rise can hardly be thought to be due to an increase in the absolute number of cases of rectal cancer; it is more probably relative, and connected with the growth of the population within the area having the right of admission to the Clinic (*i.e.* the City of Malmö).

The symptomatology in rectal cancer is sufficiently well-known to be passed over here. One thing, however, may be worth stressing. It seems to be rather a common belief that *hemorrhoids* are often combined with rectal cancer: In relevant literature, the frequency rates vary between 7 and 25 per cent. Judging from the present material, hemorrhoids occur somewhat sparsely in cancer of the rectum, having been noted in only 9 per cent of the cases. Possibly the estimation of the frequency rates is influenced by the fact that patients seeking consultation on account of rectal bleedings often state that they "have hemorrhoids".

In rectal cancer the time of illness varies considerably. It might be expected that, with the population of a big town, comparative ease of access to physicians combined with short distances and a good public transport system would produce a shorter interval. But this is not the case: 56 per cent of the patients have been admitted only after a 6 months' interval from the first symptomatic manifestations; in a few cases the interval has amounted to two years. 21 per cent of the patients have sought medical assistance for troubles of such a nature that a carcinoma of the rectum should have been suspected; the illness has not been thoroughly diagnosed, however, and precious time has been wasted on inadequate treatment. This is illustrated by the following figures:

Radical operability in delayed cases . . . .	17 %
"                    "                    " the other cases . . . .	36 %

In order to obtain better results from the treatment of rectal cancer, early surgical treatment is obviously necessary, and here the surgeons are in a very high degree dependent on the watchfulness and diagnostic skill of the practitioners.

To judge of the operability in rectal cancer is sometimes very difficult and demands great surgical experience. The percentage figures in the relevant literature vary considerably. Regard must be paid both to the general condition of the patient (age, heart and renal functions etc.), and to the extent of the cancer. Fixation of the cancer to the perirectal tissues is certainly a very grave sign, but it does not necessarily mean that the tumour is inoperable. It is often impossible to decide whether the tumour is operable or not until the abdomen is opened and the tumour and its surroundings and the liver have been examined.

According to our records, 45% of the cases were in such a condition on admission to the Clinic, and showed such a spread of the cancer, that they were considered to be outside operable possibility. In 40% it seemed possible to perform a radical operation after the usual preoperative measures: 15% of the patients received preoperative radiological treatment. Our operability rate — 55% — corresponds with those found by GABRIEL (1938): 60 %, SCHMIENCKE (1941): 50 % and COLLIER and RANSOM (1944): 56 %.

The choice of method for radical operation is largely governed by two considerations: firstly can the sphincter ani be spared or not; secondly can the operation be performed in one seance

or is more than one necessary. It is, however, not my intention to give a detailed survey of all operative methods recommended. Amputatio recti and resectio recti each has its own advantages. The former method is considered to be less dangerous than the latter; the indications in the relevant literature are that amputation of the rectum gives a greater probability of radical success.

On the other hand, a patient with an iliacal anus is socially worse situated as compared with a person who still has a functioning sphincter, although an anus iliacus in most cases allows of a fairly tolerable existence; in an even worse situation is a patient with an anus sacralis.

There are considered to be many advantages in operating in stages; lower risks of infection, better means of emptying the bowels before the radical operation, etc. But on the other hand the operation in stages necessitates the patient standing two or more laparotomies with all the risks connected therewith.

At the Malmö Clinic we have tried to carry out the radical operation in rectal cancer in one stage and to preserve the sphincters as far as possible. The operative methods used in the Clinic have been as shown in the following table:

Nature of operation.	Method.	No. of case:
Radical operation	Resection . . . . .	66
	Amputation . . . . .	13
	Excision . . . . .	8
Palliative operation	Exploratory laparotomy	34
	Colostomy . . . . .	19
	Electrocoagulations, etc.	16

Before the operation the bowels are carefully voided; the patients are given plenty of fluids and are allowed up in the usual manner during the days preceding the operation.

After the median incision, the abdomen is explored. If metastasis is found to be present in the liver or if the carcinoma has such a local spread as to make extirpation impossible, then the abdomen is reclosed, or — in cases of stenosing tumours — an anus praeter-naturalis created by means of a special incision in the left iliac fossa.

When operating carcinomata situated high up in the rectum, the resection has often been performed as an abdominal operation, otherwise abdomino-perineally. For the performance of a resection



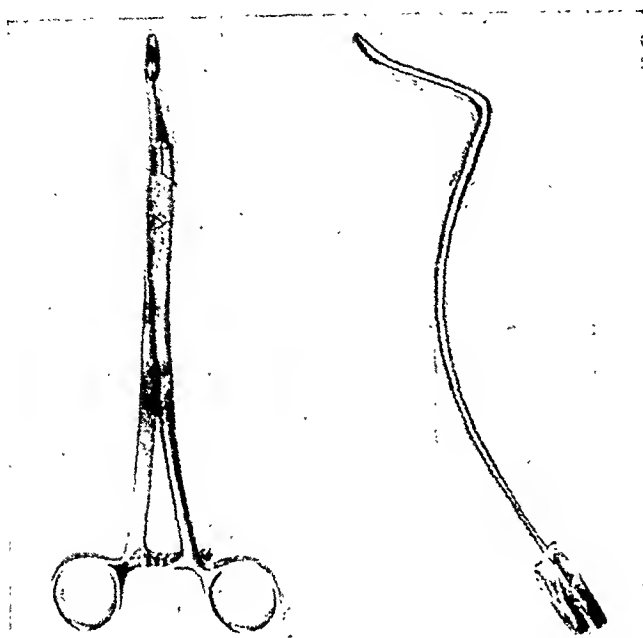


Fig. 2. LÖFBERG's clamps, constructed specially for resection of the carcinomas coli pelvini and recti.

at least 5 cm of sound mucous membrane is required between the tumour and the anus. At the place decided upon for the resection, the serosa of the intestinal wall is freed from fat. Care is taken not to damage the blood nutrition of the remaining part of the rectum. LÖFBERG's clamps, specially constructed for these operations, are then applied (Fig. 2), and the affected part of the rectum is removed. The handles of these clamps are bent backwards, thus leaving the field of operation open to the surgeon during the following suture, which is continuous and made in three rows (Fig. 3). The clamps must be soft in the gap in order to eliminate the risk of necrosis in the intestinal wall and it is important that the parts of the peripheral branches grasping the intestine, should be quite parallel. LÖFBERG's clamps are suited both for abdominal resection (in high-lying rectal cancers) and for sacral wounds (low situated cancers). The abdominal wound has always been closed primarily; the sacral wound is drained with rubber tubes and xeroform-gauze; in recent years sulfathiazol powder has been sprinkled into the wound.

All operations have been performed in narcosis with ether on an open mask; there have been no complications from the narcosis.

As a rule a catheter has been inserted during the operation.

Various points of view have been brought forward in the literature bearing on disturbances of the bladder function after large operations for rectal cancer. Incontinence appears therefrom to be rather a rare complication; BARNEY and KELLEY (1937) observed only a few cases in their material, covering 200 cases.



Fig. 3. The clamps in position on the rectum; resection is done and the clamps are brought together for the sutures (end to end). Due to the backwards bending of the handles the field of operation is open for the surgeon during the suture.

Compared with incontinence, post-operative retention occurs much more frequently. CLAIRMONT (1925) notices retention regularly, JONES (1937) in 95 per cent, GOETZE (1936) in 75 per cent, FELL (1938) in 61 per cent of cases.

The question whether some methods of operation are more apt to cause complications of the urinary tract than others has been the subject of discussion. HOCHENEGG and others are of the opinion that urinary retention appears more often after perineal operations; GOETZE, however, reports in his material on rectal cancer (mostly sacrally operated cases) a lower retention frequency than in other operative methods.

Opinions are divided on the question of whether urinary retention appears more often in men than in women. JONES and

KENNEY find the complication more often in men; FELL, however, reports the opposite to be the case.

It seems to be agreed that post-operative retention is transient and that the prognosis is good, provided that no infection of the urinary tract occurs (LOCKHART-MUMMERY, HICKS and others); in extirpation of the rectum some nerve fibres belonging to nerv. pelvici and plexus hypogastricus are removed, but there usually remains enough to allow of a restitution.

When describing our technique in the resection it was pointed out that there is great need to beware of damaging the blood nutritional system; care in this direction also benefits the innervation of the pelvic organs. This explains perhaps why, in our records, so few cases of post-operative urinary retention are seen (7.5 %), and where they have occurred, they have passed off after a few days of catheterization. No serious complications of the urinary tract have been observed.

After the operation great care is taken to ensure continuance of peristalsis: the patients are at an early stage given a mild laxative of Karlsbader and paraffin. The patient attains quite often spontaneous defecation 3—4 days after the operation. Naturally, fluid is administered per os, as well as parenterally.

The mortality in direct connexion with the operation is estimated to 21 per cent; in 8 cases the cause of death was peritonitis (originating from the wound), in 6 cases a failure of the circulatory apparatus (these patients were all over 60 years of age). Six cases died at the hospital one month or more after the operation from various complications: pneumonia, thrombo-embolia etc., on account of which the hospital *mortality rate is 30 per cent*. This mortality rate seems relatively high; it is, however, difficult to get a true comparison, for it is often impossible to deduce from other casual statistics, whether carcinomata of the colon pelvinum are included or not. If these latter are included, the mortality rate is lowered, since these carcinomata have a lower operative mortality than the carcinomata of the rectum.

It has been pointed out in relevant literature, especially by KIRSCHNER, that after a resection there will be persistent fecal fistulae and defective sphincter control. In the material under consideration, a temporary fecal flow has been noted in the sacral wound in some cases, it is true; but in 60 per cent of the surviving resected cases the operation wound has healed primarily. In the remaining cases a temporary fecal fistula arose, necessitating a

prolongation of 4—5 weeks of the stay in hospital. In the primarily healed cases the treatment at the hospital varied between 2 and 8 weeks. It should be observed that all the resected cases were completely healed when discharged and had perfect control of the anal sphincters.

On re-examination all the patients were identified, and those still living were examined; the 5-year cure after resection was 50 per cent (the 3-year cure was 64 per cent). In order to make a comparison the following figures may be quoted: FINSTERER (operation on approximately the same method as the above) 52 per cent, KIRSCHNER (operation in 2 stages) 50 per cent; GULEKE (perineal operation) 49 per cent. Patients of active age have been able to resume their work (*e. g.* labourers, policemen, railway porters etc.). Most patients had normal daily defecation, though a few used some mild laxative. None of the re-examined patients complained of defective control of sphincter ani.

As regards *amputatio recti* with anus iliacus, our experience is limited to 13 cases. This operation, performed in one stage in 11 cases, and in two stages in 2 cases, has been used in low situated rectal cancers (where resection was out of the question), and in some cases of broadly fixed tumours (*i. e.* in cases with unfavourable prognosis) which explains our high primary operative mortality: 61 per cent.

The third method of radical operation — electroexcision of the tumour — has been performed per rectum after dilatation of the sphincter or through a perineal incision to the affected portion of the rectum. Eight such operations have been performed on small cancers or carcinomatous polypi with one death (of cerebral metastasis 4 months after the operation). The re-examination of the 7 surviving patients showed that 3 were living after 8 years, 2 years, and 8 months respectively; the other four had died of metastasis within 2 years after the operation. The operation is easy to perform, but gives no clue to the probability of eventual metastasis, which is well-known as being likely to develop at an early stage in cases of small carcinomata.

The palliative operations need only be touched on briefly.

*Colostomy* respectively *explorative laparotomy* has been performed in 53 cases. As mentioned before, such an extensive spread of the cancer has sometimes been found in what was planned as a radical operation, that resort to this unsatisfactory operation was necessary. *Colostomy* has been necessitated by imminent ileus

symptoms. The initial mortality rate was in the colostomies 42 per cent, in the explorative laparotomies 12 per cent. The high mortality in colostomy is, of course, not due to the operation as such, but to the conditions obtaining during the operation: *e. g.* ileus condition, affected patients etc.

Finally a few words may be said about the *roentgenological treatment of rectal cancer*. X-ray treatment has been considered to be indicated: 1, as preoperative treatment of carcinomata, the operability of which is uncertain on admission and which are hoped to be made amenable to surgery; 2, in clearly inextirpable cases with a tolerably good general condition so that something had to be done in order to moderate the growth of the tumour. X-ray treatment has also been given to a small number of cases which were considered operable but where there was refusal to submit to any surgical treatment.

In this material, radiological therapy has been given preoperatively in 16 later on radically operated cases: in 127 cases irradiation has been the sole treatment, or has been combined with colostomy performed later on (in connexion with an ileus).

It is very difficult to give an opinion on the effect of X-ray treatment on rectal cancer. In the relevant data there are, however, cases which have survived for 4 years with repeated radiological therapy. In the present series the patient treated by irradiation without surgery had a mean length of life of  $1\frac{1}{2}$  years. This figure agrees closely with that indicated by a large amount of American material recently reported by SHARP.

Finally a small group of cases may be mentioned, which were of such a poor prognosis that no therapy was contemplated. These patients died in the hospital or shortly after returning home.

### Summary.

During the years 1919—1943, 276 cases of carcinoma of the rectum have been treated at the Surgical Clinic in Malmö. 55 per cent were operable and in 66 cases a resection of the carcinoma was performed in one stage and with preservation of the anal sphincter. The operation mortality has been 30 per cent. There are no inefficiency symptoms from the anal sphincters and no fecal fistulae. The 5-year cure is 50 per cent.

Clinical experience at Malmö appears to indicate strongly that

the importance of preserving the anal sphincters is greater than seems at present to be generally accepted; it also appears that the indications for resection should be on a broader basis, particularly as the risks of persisting fecal fistulae, and disturbances in the sphincter control respectively seem to be over-estimated; moreover the 5-year cure in resection seems to be quite as good as in amputation.

### Zusammenfassung.

In den Jahren 1919—1943 waren in der Chirurgischen Klinik in Malmö 276 Fälle von Cancer recti in Pflege, von denen 55 % operabel waren, und bei 66 dieser Fälle wurde einseitige Resektion des Krebses mit Erhaltung des Sphincter ani vorgenommen. Die Operationsmortalität betrug 30 %. Keinerlei Insuffizienzsymptome seitens des Analsphinkters sind vorgekommen, keine Fäkalfisteln. Gesund nach fünf Jahren 50 %.

Das Material scheint dafür zu sprechen, dass es angezeigt ist, in grösserem Ausmasse, als was jetzt der Fall zu sein scheint zu versuchen den Sphincter ani durch Erweiterung der Indikationen der Resektion zu erhalten, umsomehr als die Gefahr persistierender Fäkalfisteln und Störungen der Sphinkterkontrolle offenbar übertrieben worden ist, und der Heilungsprozent nach fünf Jahren bei Resektion reichlich so günstig zu sein scheint wie bei Amputation.

### Résumé.

De 1919 à 1943 on a soigné à la Clinique Chirurgicale de Malmö 276 cas de cancer du rectum, dont 55 % étaient opérables, et chez 66 de ceux-ci on a pratiqué la résection du cancer en un temps avec conservation du sphincter anal. Mortalité opératoire de 30%. Il n'y en a ni symptômes d'insuffisance sphinctérienne, ni fistules fécales. 50% de guérisons après 5 ans.

Ce matériel paraît montrer qu'on devrait essayer, plus souvent que ce ne semble être le cas aujourd'hui de conserver le sphincter anal en étendant les indications de la résection, et cela en particulier puisque le risque de voir persister des fistules fécales ou des troubles de la fonction sphinctérienne a tout l'air d'avoir été exagéré, et que les chances de guérison après 5 ans apparaissent bien aussi bonnes avec la résection qu'avec l'amputation.

## References.

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## **An Investigation, by Experiments on Animals, of the Rôle Played by the Epiphysial Cartilage in Longitudinal Growth.**

By

ARVID HELLSTADIUS.

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Through many investigations, it has been securely established that the growth of the long bones takes place from both ends of the bone. By inserting, at certain intervals from another, metal pegs into the diaphysis, it has been possible to demonstrate that the spaces between these pegs do not increase during growth, and that consequently no interstitial longitudinal growth occurs. Thus for the longitudinal growth of the diaphysis, solely the ends of the latter are responsible, and the deciding part in this process is played by the epiphysial cartilage.

It was thought that the longitudinal growth of the diaphyses is entirely due to enchondral ossification between the epiphysial cartilage and the diaphysis, and that the epiphysial cartilage as such hereby plays an active rôle. The correctness of this classical conception was, however, questioned at first by POLICARD and afterwards also by NOVÉ-JOSSERAND.

POLICARD states that in longitudinal growth progressive ossification from two different growth centres occurs. One of these is situated on the border-line between diaphysis and epiphysial cartilage — the line of enchondral ossification. The other's site is within the perichondrium, viz. near the end of the cortical bone. The latter forms a cylinder, into both openings of which those parts of the epiphysial cartilage protrude, where the enchondral ossification takes place. The periosteum of the cortical bone merges directly with the perichondrium covering the epiphysial cartilage, and here a perichondral, progressive, intermembranous



ossification occurs. The bone formed perichondrally thus includes, like a tube, that formed enchondrally. POLICARD considers it possible that the longitudinal growth is due chiefly to new bone formation within the perichondrium, whereas enchondral ossification plays but a secondary part. He points out that in experiments designed more or less to destroy the epiphysial cartilage and thereby to inhibit longitudinal growth, the perichondrium, in which the growth of the cortical bone takes place, is also injured.

NOVÉ-JOSSERAND calls attention to the fact that in many instances after incisions into, or disruptions of, the epiphysial cartilage no appreciable derangement of growth develops. He quotes various cases of osteitis, where the epiphysial cartilage has been destroyed to a certain extent without growth being impaired. In his opinion the part played by the epiphysial cartilage is a purely passive one, the sole purpose of the epiphysial cartilage being to prevent accretion of diaphysis and epiphysis. Thus the lesion of the epiphysial cartilage *per se* is said not to inhibit longitudinal growth, this being the case only if the lesion of the epiphysial cartilage becomes so extensive as to result in osseous uniting of diaphysis and epiphysis. NOVÉ-JOSSERAND, on the other hand, deems POLICARD's hypothesis unlikely, according to which longitudinal growth is due principally to new bone formation within the perichondrium.

Apart from NOVÉ-JOSSERAND and POLICARD, the general opinion seems to be, no longitudinal growth without epiphysial cartilage. Cases where the epiphysial cartilage, according to all circumstances, has been destroyed by osteitis without any inhibition whatsoever of longitudinal growth occurring, are explained by compensational increase of longitudinal growth from the other end of the diaphysis, which can happen, as established by OLLIER (quoted by BERGMANN). This naturally is also the case in instances where an osseous connection between diaphysis and epiphysis has developed in consequence of destruction of the epiphysial cartilage, since there all longitudinal growth from the damaged diaphysis end is precluded. However, in the same way even those cases are explained, in which such an osseous connection was absent (*e. g.* BENNET).

The results of various experiments on animals may be considered to have constituted a contributory reason for this conception, viz. that the activity of the epiphysial cartilage is essential in

longitudinal growth. After extirpation of the epiphysial cartilage osseous accretion between epiphysis and diaphysis develops, this as a matter of course preventing any longitudinal growth whatsoever from the diaphysis end in question. But even after less extensive injuries to the epiphysial cartilage, *i. e.* after partial excision, insertion of metal pegs, etc. into the epiphysial cartilage, inhibition of longitudinal growth has sometimes been observed. However, also in such cases bone bridges, in certain places crossing the otherwise uninjured epiphysial cartilage and connecting epiphysis and diaphysis, may be found. The inhibited longitudinal growth cannot here be attributed directly to the destruction of cartilage cells as such, and to thereby impaired activity of the diaphysial cartilage, being caused instead by the osseous accretion between epiphysis and diaphysis. For conclusions as to the significance of the epiphysial cartilage to be derived from injuries to the latter, it is essential that the development of osseous connections between epiphysis and diaphysis has been absolutely precluded. Such investigations have not been carried out, at least as far as I was able to ascertain from literature.

For this reason I studied in some experiments on animals the longitudinal growth after extirpation of the epiphysial cartilage, thereby, in order to prevent derangement of growth due to osseous accretion between epiphysis and diaphysis, removing also the epiphysis. In other cases in addition a more or less large portion of the adjacent diaphysis was resected. The animals used in the experiments were young rabbits, *viz.* about 2 months old. The operations were performed on the lower end of the ulna. The parallel bone, *i. e.* the radius, here prevents collapse of the resected part. The longitudinal growth was measured from a piece of wire inserted into the ulna diaphysis during the operation.

*Exp. 1.* In the lower end of the ulna the epiphysis with the entire epiphysial cartilage was extirpated. In order to be able to measure the longitudinal growth from the diaphysis end in question, a hole was drilled through the diaphysis  $\frac{1}{2}$  cm. above the lower end, a piece of wire (stainless steel) being inserted.  $2\frac{1}{2}$  months later the animal was killed, and the bones of the lower part of the foreleg on each side were removed for X-ray examination. The skiagrams reveal that both radius and ulna of the foreleg operated on had become curved, the lower ends of the radius and the ulna consequently pointing in the ulnar direction. The lower portion of the ulna was broader than normal. Radius and ulna were both shorter — *i. e.* had grown less in length — than on the side not operated on. By means of the wire inserted on operation into the

ulna diaphysis the longitudinal growth from the lower end of the ulna could be measured. The lower end of the ulna had then, during the  $2\frac{1}{2}$  months having elapsed since the operation, increased its length by 19 mm. The total length of the ulna was on the left side 66 mm., and on the right 77 mm.; the length of the radius amounted to left, 55 and right, 65 mm. Thus, also as regards the radius, an appreciable inhibition of growth had taken place, to a somewhat lesser extent, however, than in the ulna. The difference in length between ulna and radius was thus 12 mm. on the right side and 8 mm. on the left. Histologically, an epiphysis on the lower end of the left ulna was found. A new epiphysial cartilage had also developed. Its course was markedly irregular, and the normal longitudinal linear arrangement of the cartilage cells was lacking. At the ulnar side were bone trabeculae crossing the epiphysial cartilage and connecting epiphysis and diaphysis with one another. The epiphysial cartilage separating the lower part of the radius diaphysis from the epiphysis had grown forth along the ulnar surface of the radius, merging there into the atypical epiphysial cartilage between diaphysis and epiphysis of the ulna.

Thus, despite extirpation of the epiphysial cartilage and the epiphysis on the lower end of the ulna, considerable growth (viz. 19 mm.) from the lower end of the diaphysis had taken place, although the increase was smaller than on the side not operated on. In addition a new epiphysis with irregular and atypical epiphysial cartilage had developed. The possibility therefore cannot be disregarded that the epiphyseal cartilage had not been entirely removed on operation, regeneration of epiphysis and epiphysial cartilage having originated from remaining portions of the former. Perhaps it can even be assumed in this case that the regeneration had started from the adjacent epiphysial cartilage of the radius. This conception is supported by the epiphysial cartilage of the radius merging into the new atypical epiphysial cartilage of the ulna, as was ascertained on histological examination.

There is evidence, even as regards man, that epiphyses can be re-formed after extirpation. Thus BECKER quotes the case of a boy, where the head of the radius was resected after traumatic epiphysiolysis. Skiagrams made two years after operation showed regeneration of the radius head having occurred. A similar case has been reported by JANZ.

*Exp. 2.* In the lower portion of the left ulna the epiphysis together with the entire epiphysial cartilage was extirpated. The exposed lower end of the diaphysis was carefully eurented, in order to preclude areas of cartilage to remain.  $\frac{1}{2}$  em. higher up a hole was drilled through the ulna diaphysis, a piece of wire (stainless steel) being inserted. Also

within the lower part of the right ulna diaphysis a wire was inserted into a hole drilled there. Afterwards skiagrams were made at certain intervals, the distance between X-ray tube and film being identical for all exposures. In skiagrams made as early as 3 days after operation the distance between the wire and the lower end of the diaphysis was left, 4 mm. and right, 9 mm; after two months the corresponding figures were 8 and 20 mm. respectively, and after further 7 weeks, when the animal was killed, they were left, 9 mm. and right, 27 mm. (Fig. 1). The lower end of the ulna was of normal thickness. The lower end of the radius was bent towards the ulna. The length of the radius was left, 57 mm. and right, 65 mm. Thus from the lower diaphysis end of the left ulna an increase in length amounting to 5 mm. had taken place, whereas the corresponding figure for the right, not operated-on, side was 18 mm. The difference accordingly was 13 mm. During the same time the left radius had grown 8 mm. less than the right. Histological examination showed the medullary cavity within the lower portion of the left ulna to be blocked by new bone, and from this osseous tissue bone trabeculae extended into the subjacent connective tissue. No cartilaginous tissue was to be found there.

In this experiment the lower epiphysis and the entire epiphyseal cartilage had been extirpated, and yet a certain longitudinal growth (5 mm.) from the diaphysis end in question had occurred; the increase being smaller, however, than on the not operated-on side. Neither epiphysis nor epiphyseal cartilage had re-formed. The longitudinal growth had progressed through ossification from the diaphysis end into the subjacent connective tissue.

In this as well as in the preceding experiment, as regards the radius, conspicuous inhibition of growth had taken place, though not quite so well-marked as in the ulna. As a consequence of the operation the animal diminishes the strain placed on the operated limb by shifting a greater part of its weight on to the undamaged leg. Still, inactivity is not the cause of the growth derangement in the radius. In the latter experiment the length of both thigh-bones was also measured on autopsy, these being found to be of identical length. Had the inhibition of growth in the radius been due to inactivity, it would have manifested itself in the thigh-bones too. The result of the resection of the lower end of the ulna is a lateral deviation of the paw with, in consequence, a change of the strain operating upon the end of the radius. Possibly the growth derangement, either as a whole or partly, can be due to this circumstance. It might, nevertheless, seem probable that the inhibition of growth in the ulna, apart from the altered conditions of strain placed on the limb, also more immediately restrains the growth of the parallel bone.

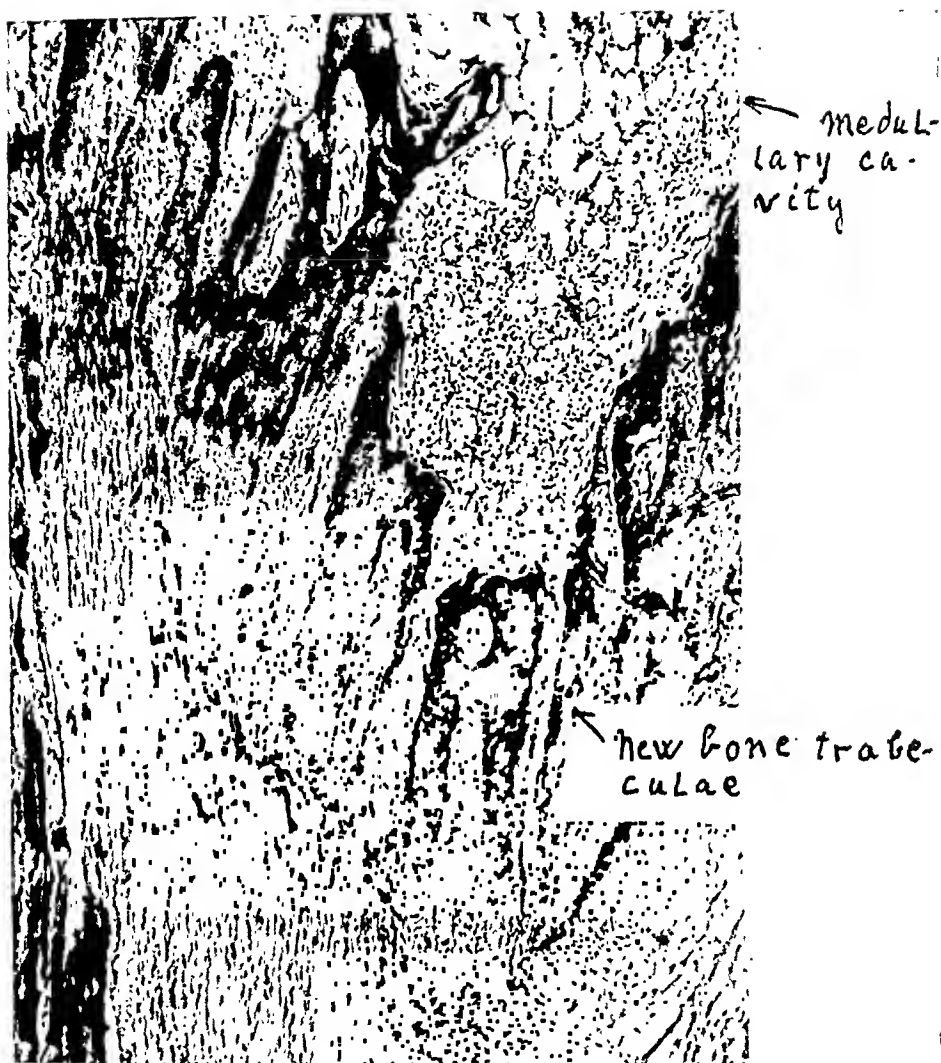


Fig. 3 (Exp. 3).

Despite extirpation of the epiphysial cartilage and the epiphysis, longitudinal growth from the diaphysis has taken place. The osteoid bone trabeculae grow, principally from the medullary cavity, in a longitudinal direction into the subjacent tissue.



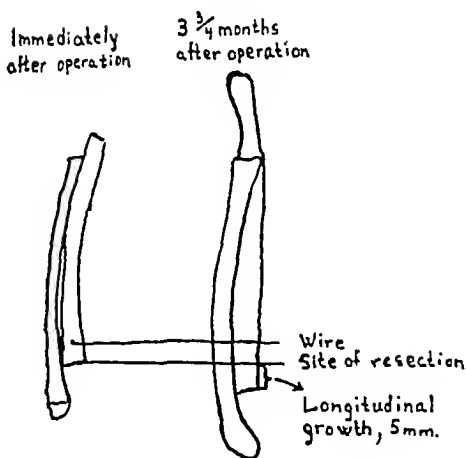


Fig. 1 (Exp. 2).

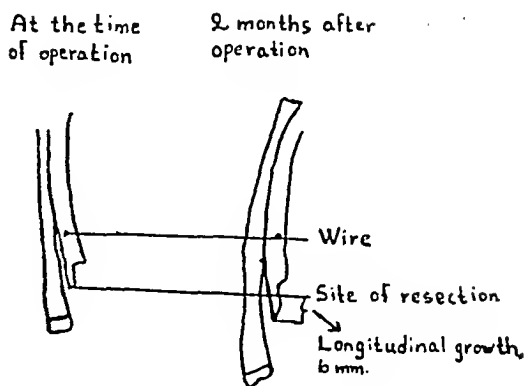


Fig. 2 (Exp. 3).

*Exp. 3.* At the lower end of the left ulna the epiphysis and epiphysal cartilage were extirpated. In addition  $\frac{1}{2}$  cm. of the ulnar portion of the metaphysis was removed, only the radial portion being left to reach the epiphysal line (Fig. 2). 1 cm. above the latter a piece of wire was inserted through a hole drilled into the diaphysis. The lower diaphysis end had after 2 months, when the animal was killed, increased its length by 6 mm. Histological examination revealed osteoid bone trabeculae growing from the lower end of the ulna — viz. principally from the medullary cavity — in a longitudinal direction into the subjacent connective tissue (Fig. 3). The new bone trabeculae were extensively covered by osteoblasts. There were no remains of epiphysal cartilage.

Thus, also in this experiment, despite extirpation of the lower epiphysal cartilage and epiphysis, a certain longitudinal growth (6 mm.) from the lower end of the diaphysis had taken place.

Microscopically, neither in Exp. 2 nor in Exp. 3 could any remains whatsoever of epiphysal cartilage be detected. This is evidence in favour of the epiphysal cartilage having been completely removed on operation, and, in consequence, of the growth not being due to remaining areas of epiphysal cartilage. Perhaps, however, the possibility of growth being completed as the animal was killed, and of possibly existing epiphysal cartilage having been used up during the longitudinal growth occurring, cannot be entirely disregarded.

In order to preclude with certainty that a portion of the epiphysal cartilage was left on the diaphysis end at the operation, in the following experiments not only the epiphysis and epiphysal cartilage were extirpated, but in addition the part of the diaphysis bordering on the epiphysal cartilage.

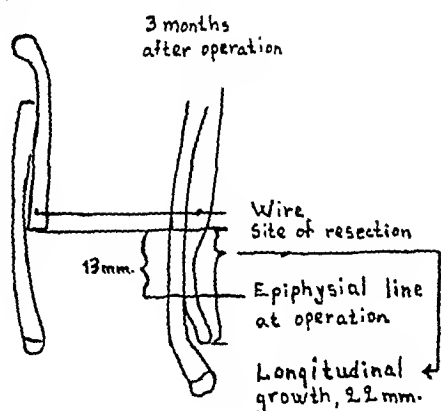
Immediately  
after operation

Fig. 5 (Exp. 5).

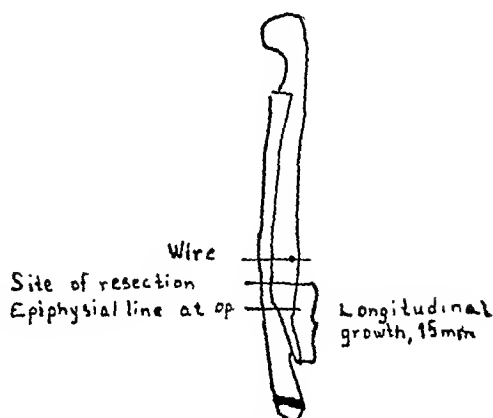


Fig. 6 (Exp. 6).

had grown forth from the lower resection surface. The distance between the wire and the lower end of the newly formed part of the ulna was 17 mm., and the longitudinal growth from the site of resection in the ulna diaphysis amounted accordingly to 12 mm. In a skiagram made after a further month the distance between the wire and the lower end of the ulna was 20 mm., the growth being consequently 15 mm. Both ulna and radius were on the left side shorter than on the right. The ulnar curvature of the radius was in this case inconsiderable. The lower radius epiphysis was on the left side longer and more tapering than on the right side. The length of the entire left ulna was 63 mm., that of the right (without the epiphysis) 75 mm. The total length of the left radius was 61 mm. and that of the right 63 mm. Histologically, there was formation of osteoid tissue progressing within the connective tissue beneath the site of resection.

In the three last experiments detailed above, thus not only the epiphysis and the epiphysial cartilage were extirpated, but in addition a piece of the lower diaphysis end. In these instances too a not inconsiderable longitudinal growth from the resected diaphysis end was noted (in one of the cases 22 mm. during 2 months). The new bone growing forth from the resected ulna diaphysis has, as regards length, not only substituted the resected portion of the diaphysis, but has induced a surplus increase in length of the diaphysis. In Exp. 4 the new bone was, certainly, not more than 3 mm. longer than the resected piece of the diaphysis; however, it was in Exp. 5 9 mm., and in Exp. 6 10 mm., longer than the removed part of the ulna diaphysis. In Exp. 1 and 2, where only the epiphysis and the epiphysial cartilage had been extirpated, the newly grown portion of the ulna had the usual



thickness of the diaphysis, showing, like a normal diaphysis, cortical bone and medullary cavity. In Exp. 4, 5 and 6, where in addition to the epiphysis and epiphysial cartilage even a portion of the lower ulna diaphysis had been extirpated, the newly formed part of the ulna was considerably smaller than a normal diaphysis, and no differentiation of osseous tissue into cortical bone and medullary cavity had taken place.

In the two following instances the ulna diaphysis was resected to a considerably greater extent, viz. more than half the diaphysis being removed.

*Exp. 7.* An osteotomy was performed on the ulna diaphysis slightly above the middle, the portion of the diaphysis below this point (its length being 32 mm.) being extirpated extraperiosteally together with the epiphysial cartilage and the epiphysis. 1 cm. above the end of the resection a wire was inserted through a drill-hole into the ulna diaphysis. A skiagram made 6 weeks later showed osseous accretion between the resection end and the radius, no longitudinal growth, however, having occurred from the end of the ulna. In a skiagram made nearly 5 months after operation, the accretion between the resection end in the ulna and the radius was still more close. No longitudinal growth of the ulna end had taken place.

*Exp. 8.* An operation similar to that performed in Exp. 7 was carried out, the lower epiphysis, the epiphysial cartilage and more than half the ulna diaphysis being resected. A wire was inserted  $\frac{1}{2}$  cm. above the site of the resection. Skiagrams made after 2 and 3 months respectively showed accretion between the ulna and the radius; there was, however, no longitudinal growth from the end of the ulna.

The two latter experiments, in which more than half the lower ulna end was resected, differ from the previous ones, where resections of the ulna diaphysis had been performed, in that no longitudinal growth from the lower ulna end could be demonstrated. The reason for this is not evident.

If POLICARD's hypothesis detailed above, viz. that the longitudinal growth is due chiefly to new bone formation within the perichondrium near the end of the cortical bone, were correct, it was, in my experiments, to be expected that the new bone formation should originate from the end of the cortical bone. This, however, was not the case. The newly formed bone trabeculae issued principally from the area of the resection surface corresponding to the medullary cavity (see Fig. 3).

Even if, as emerging from my experiments, longitudinal growth of diaphyses can take place without epiphysial cartilage, yet the

purpose of the latter is not solely to prevent accretion of epiphysis and diaphysis. The special histological structure of the epiphysial cartilage indicates a particular function of this cartilage in growth. The part played by the epiphysial cartilage may be that it provides a medium especially suitable for the processes of new bone formation progressing from the ends of the diaphyses. Probably the epiphysial cartilage thus exercises a regulating influence on these processes, inducing the growth to proceed smoothly and regularly. Obviously, however, the epiphysial cartilage does not play an active rôle by, through activity of its own, being the source of the processes leading to new bone formation during longitudinal growth.

### Summary.

After extirpation of the lower ulna epiphysis and the epiphysial cartilage longitudinal growth occurred from the lower ulna end, being, however, less extensive than on the side not operated on. If in addition a portion of the lower part of the ulna diaphysis was resected extraperiosteally, longitudinal growth from the resection end was also demonstrated, the portion of the ulna formed in this way being, however, considerably thinner than the rest of the diaphysis. Thus longitudinal growth of diaphyses can take place without epiphysial cartilage.

### Zusammenfassung.

Nach Entfernen der unteren Ulnaepiphyse und des Epiphysenknorpels erhielt man am unteren Ende der Ulna ein Längenwachstum, wenn auch geringer als auf der nicht-operierten Seite. Wurde ausserdem ein Teil der unteren Hälfte der Ulnadiaphyse extraperiostal entfernt, so erhielt man gleichfalls ein Längenwachstum am Resektionsende, wenn auch die in dieser Weise neu gebildete Partie der Ulna bedeutend sehnäher war als die übrige Diaphyse. Ein Längenwachstum der Diaphysen kann also ohne Epiphysenknorpel stattfinden.

### Résumé.

Après extirpation de l'épiphyse cubitale inférieure y compris son cartilage de conjugaison on vit croître en longueur l'extré-

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## On the Frequency of Complications, Especially Those of Long Duration, After Spinal Anaesthesia.

By

N. O. ERICSSON.

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The radical improvements which have made possible the vast increase in the use of spinal anaesthesia can be summarized as follows:

1. The introduction of hypotonic solutions.
2. Fractional and individual dosage.
3. Studies of the pathological physiology of anaesthesia.

The introduction of hypotonic solutions has brought about, amongst other improvements, one in the field of operating technique, namely that abdominal operations can now be performed in the Trendelenburg position. It is also possible to counteract a fall of the blood pressure through this position.

The method which was developed by SEBRECHTS and which was based on very considerable experience with individual and fractional dosage eliminated to a great extent the risks and disadvantages of too high or insufficient anaesthesia. Since this method of dosage, however, required a considerable amount of time, JONES et al. have attempted, by measuring the length of the spine, to ascertain the volume of the dural canal, and by this means to determine the single dose necessary for anaesthesia to a certain level. The amount of fluid, however, is not dependent on the length of the subarachnoid space alone; the direction of the flow of the anaesthetic is influenced by anatomical variations, and the sensitivity to the anaesthetic can vary considerably in individual cases. This attempt to simplify the dosage has

that even this method has contra-indications and disadvantages. It is naturally desirable to ascertain and explain them as carefully as possible. This paper intends, by the study of existing literature and examination of the writer's own cases, to contribute hereto.

### Contra-Indications.

In general it is considered that indications for spinal anaesthesia are still limited to operations below the diaphragm.

Nervous persons and children have long been considered to be less suited for every kind of local anaesthetic and thus for spinal anaesthesia. PITKIN and ETHERINGTON-WILSON, however, recommend spinal anaesthesia even for children and VARA LOPEZ has since 1930 used this method for his young patients. In a summary which the last-named made of 438 of his own cases from the age of a few months to 16 years, he shows very satisfactory results. Sequelae of the type which will be discussed later in this paper have not arisen in his cases. The reason for the great degree of tolerance shown by children is considered to depend on the relative insensivity of their vegetative nervous system.

Hypertension, cardiac diseases and poor general condition (ileus, peritonitis) were previously considered to be contra-indications for spinal anaesthesia. Nowadays the opposite opinion would appear to be prevalent.

During pregnancy there is an increased sensitivity to spinal anaesthesia, and deaths are recorded after injection of small doses (FEDERIGHI).

Organic nervous diseases should, according to unanimous opinions, be excluded from this form of anaesthesia.

### Immediate Risks.

These consist of shock or respiratory paralysis due to too high anaesthesia.

Records of the direct mortality risks vary from 1 : 200 (HOHMEIER and KÖNIG) to 1 : 17,900 (TOMASCEWSKI). In general 1 : 5—6,000 is accepted. RYGH and BESSESEN have calculated mortality at 1 : 11,000 deducting those cases in which good technique can avoid risks.

Pulmonary complications appear after operations in the upper area of the abdomen 2—3 times more frequently after ether than after spinal anaesthesia (SISE).

Besides the immediate death risk, a number of complications which are not as a rule serious appear, but which, especially if they are of long duration, must be reckoned as serious disadvantages.

### Post-Anaesthetic Complications.

*Nervous symptoms* appear in the form of paresthesiae and paresis. As a rule neurological symptoms from the upper and lower extremities do not appear to have been differentiated in earlier literature.

As a rule these sequelae are of short duration, but a number of more serious cases are also recorded. LIGHT etc. and RUSCA have recorded two deaths from paraplegia occasioned by local meningitis. LIGHT also describes 16 similar cases which have recovered.

More limited paresis and paresthesiae occur more frequently. LIENHOOP found neurological symptoms in 7 %, THORSÉN paresis with a duration of over one week in 2 (♂)—6 (♀) %, paresthesiae in 1—7 %. LIGHT records paresthesiae and mild sensory disorders in a small percentage of cases. ORKIN found paresthesiae in 0.19 % of 46,000 anaesthesias (LIGHT, etc.), LAGERGREN, HILLEBRANDT and DÜNZEN et al. have found no nervous symptoms caused by spinal anaesthesia.

*Paresis of the bladder* is said to be rarer after spinal than after inhalation anaesthesia (PITKIN et al.), LIENHOOP found retention of the urine in 3 %, THORSÉN in 1 (♂)—2 (♀) % of more than one week's duration. LIGHT et al. have, from a compilation of literature on this subject, found retention of urine in 0.4 %, of which some cases with a duration of 1—2 months. HASLER et al. are of the opinion that the operation and confinement to bed play the most important rôle in this connection.

FERGUSON and WATKINS have described 14 cases of cauda equina syndrome, of which 13 appeared during a period of 20 months, all after using the neurotoxic substance duracaine. After the authors started to use percaine such paresis has not occurred.

Paresis of the cranial nerves has aroused great interest. The most usual form is paresis of the ocular motor muscles, most frequently of the abducent nerve. This occurs in 1—2.5 % and approximately as often after novocaine as after percaïne (ARNHEIM and MAGE, LIENHOOP, LIGHT, etc., THORSÉN), FISCHER gives a figure of 0.15 %. SEBRECHTS and LAGERGREN have no such cases. All the above authors are unanimous in the opinion that these pareses recover after a short time without leaving residual damage. Such symptoms also occur after inhalation anaesthesia and after ordinary diagnostic lumbar puncture (FRANKE, LIGHT, etc.).

The reason for neurological symptoms of longer duration is not clear. PITKIN and SEBRECHTS are of the opinion that nervous symptoms in the anaesthetized area are due to trauma during puncture. FERGUSON and WATKINS hold that the anaesthetic substance damages the nerve. This is denied by others (CO TUI, etc.) in the case of percaïne and novocaine. Duracaine has, however, been demonstrated to be strongly neuro-toxic and for this reason is no longer used.

Slight meningitis and altered spinal fluid pressure are given as the causes of paresis of the ocular motor muscles (LIGHT, etc., DOMRICH, LIENHOOP). THORSÉN believes that the brain, on account of a lack of spinal fluid — a fall in the cerebro-spinal fluid pressure nearly always occurs, after spinal anaesthesia, as will be mentioned later — “does not, as is normal, float on the fluid” but drops backwards, thereby causing a tension on the abducent nerve with a resulting paresis.

*Headache* is without question the most usual sequel and is said to occur in as varying frequencies as 0.1—29 %, usually 10—25 % (BACKER-GRÖNDAL, LIGHT, etc., NYGAARD, SÖGAARD, THORSÉN). The duration amounts to more than one week in 3 (♂)—10 (♀) % (THORSÉN). It can last for as long as a year (LIGHT, etc., THORSÉN). Headache occurs in between 12—25 % of cases after ordinary lumbar puncture (HEHN, LIGHT, etc.).

Opinions vary as to the cause of headache. Meningeal irritation of bacterial or chemical nature (SCHMIDT, LIENHOOP et al.) can possibly be the reason, but such cases are too rare or too insignificant to be the principal cause (BACKER-GRÖNDAL et al.).

The cause is now more often considered to be connected with the fall in cerebrospinal fluid pressure which occurs in 87 % of cases after spinal anaesthesia (HOSEMAN). This is most simply

explained by a leakage through the puncture wound in the dura. By plugging this hole with catgut, NELSON has succeeded in diminishing the frequency of headache.

Other authors consider the leakage theory to be erroneous (BACKER-GRÖNDAL, SEBRECHTS et al.) since the frequency of headache is not influenced by the size of the puncturing needle. It is assumed that the fall in pressure arises through a diminished secretion of fluid due to the action of the anaesthetic on the choroid plexus (ZAPPALA) or by its effect on the vessels of the spinal canal.

SEBRECHTS et al. explain the occurrence of headache as occasioned by a considerable pressing-down of the medulla oblongata in the foramen magnum by reason of a lack of fluid, whilst at the same time an over-production of fluid increases the pressure in the cranium. BACKER-GRÖNDAL is of the opinion that headache, twice as usual in persons with neurotic stigmata, is a nervous constitutionally affected reflex.

*Nausea and vomiting* are less common after spinal than after inhalation anaesthesia in extra-abdominal operations (NYGAARD, LIGHT, etc.). VARA LOPEZ and LIENHOOP give 0.5—5 %, SCHMIDT 10 %, THORSÉN 15 (♂)—48 (♀) %. LAGERGREN and SEBRECHTS find less nausea following the use of their method than after local anaesthesia. The material in the relevant literature is, however, not homogeneous, since the nature of the operation is not as a rule stated.

*Vertigo* has not aroused much interest in literature in this field. THORSÉN gives the frequency as 4 (♂)—12 (♀) %, of which 2—5 % of cases with a duration of more than one week.

*Backache* occurs often as a minor discomfort and seldom in more serious forms (0.02 LIGHT etc.). LIENHOOP records 3 %, THORSÉN 2 (♂)—22 (♀) %, in some cases of long duration. NYGAARD's figure of 6—8 % noted backache as occurring as often after ether as after spinal anaesthesia. A meningeal reaction is assumed as the cause, or else a release of a latent dorsal insufficiency.

Women are recorded as suffering more often than men from post-operative sequelae, and younger age-groups than older.

The importance of the dosage for the occurrence of late symptoms has not been discovered. As a rule such sequelae are more common after major operations, but this can depend on the nature of the operation (BACKER-GRÖNDAL).

Therapeutic treatment of post-operative sequelae, especially headache, include intra-dural injections of physiological saline (JACOBÆUS), glucose solution (ZAPPALA) and Ringer's solution (THORSÉN), all with the object of increasing the amount of cerebrospinal fluid. HILLEBRANDT and DÜNZEN have achieved satisfactory results with intravenous injections of hypertonic glucose solution. VRBA prefers pituitary preparations, BACKER-GRÖNDAL nitroglycerine.

### The Writer's Own Material and Technique.

For this investigation the cases under observation have consisted of all the cases of spinal anaesthesia at Maria Hospital during 1939—42. Solutions of percaine 1 : 1,500 and novocaine 5 % have been used, the former (hypotonic) for fractional spinal anaesthesia according to SEBRECHTS and the latter (hypertonic) for single-dose anaesthesia according to SEMB. The total number of cases was 1,296 of which 129 have died during hospitalization or later. We have been unable to contact 181 and a large number of these are probably dead, since this group included many cases of malignant growths. The remaining 983 have been subjected to a carefully specified questionnaire. This was sent out between 1942 and 1944 in order to reach a sufficiently long observation period for the later year-groups. Answers have been received from 80 % of the 983 patients, *i. e.* 784. These answers, together with the case-histories and anaesthesia records have served as the basis of the investigation. A number of patients have been followed-up by clinical examination. When the material is now published, in spite of the weaknesses which must exist in such a procedure, it is with the thought that the frequency figures thus found must be maxima. The post-operative complications have, in practically every case, been subjective. Personal examination has shown, in some cases, another cause of the complications than the anaesthetic.

The 784 patients who have answered the questionnaire can be divided as follows:

Percaine anaesthesia according to SEBRECHTS (1 : 1,500) .....	323
Do. with supplementary inhalation a. ....	97
Novocaine anaesthesia according to SEMB (5 %) .....	351
Do. with supplementary inhalation a. ....	13



### Immediate Risks.

In only one case was the spinal anaesthesia primarily responsible for the death of the patient. This was the case of a 68-year-old male, who had suffered paralysis of both legs at the age of 20 after a "cold". The paralysis was completely reversible and he appears not to have received hospital care. He was received into hospital suffering from an acute cholecystitis and examination showed a serious myocarditis. Owing to a rise in temperature and increasingly poor general condition, an operation was decided on after a couple of days. After an ordinary lumbar puncture 5 cc of percaine was injected. He appears to have suffered no discomfort at puncture. After 5 minutes, when the anaesthesia had reached the iliac crests, the patient was turned onto his face. One minute later his condition suddenly became serious, he was cyanosed, unconscious, with imperceptible pulse. He received strong stimulants and intravenous drip was set-up. When his condition improved to the extent that he could be examined, he showed a paraplegia which afterwards persisted. Neurological examination revealed complete paralysis and dissociated anaesthesia in the legs. He died after a little more than a month of infection of the urinary tract. Autopsy: Pronounced cardioarteriosclerosis. No extradural or subdural haemorrhages. Degenerative changes in the lumbar enlargement of the spinal cord in an area of 1 dm. Diagnosis: Status post haematomyelia. The mechanism for the production of the haematomyelia is obscure. Direct punctural trauma or injection of the anaesthetic into the grey matter of the spinal cord is out of the question in this case. MONRAD-KROHN points out that haematomyelia can occur even after very mild trauma, but considers that there must be a predisposition and that trauma is only the apparent cause. Since this patient has earlier suffered from paraplegia, a predisposition may have existed. Had his earlier illness been known before the operation, another form of anaesthesia had probably been chosen. No other deaths have occurred in which anaesthesia can be presumed to have played any rôle.

## Post-Anaesthetic complications.

### Symptoms from the anaesthetized zone.

Amongst the post-anesthetic sequelae nervous symptoms from the anaesthetized zones of the body are naturally of the greatest interest. These have consisted of paresthesia or certain feelings of numbness in some part of the anaesthetized zone. Their frequency and duration are shown in the following table:

% of sequelae	> 1 week	> 1 month	> 2 months	> 6 months
SEBRECHTS .....	0.9	0.3	0.3	—
do. with inhalation anaesthesia .....	3.1	1.0	1.0	—
SEMB .....	0.9	0.6	0.6	0.3
do. with inhalation anaesthesia .....	—	—	—	—

Of these cases,  $\frac{1}{3}$  have had symptoms from one leg,  $\frac{1}{3}$  from both legs and  $\frac{1}{3}$  from both arms and legs. In addition 5 cases with feelings of numbness have occurred more than 2 months after the anaesthesia (in two cases more than 6 months after the anaesthesia). Here the anaesthetic seems not have been the cause.

No marked cauda equina syndromes have occurred. A certain paresis of the bladder with retention of urine has occurred in 1.7 % with a duration of 4—7 days, in 0.4 % with a duration of more than one week, maximum 10 days. It has been possible to avoid serious infections of the urinary tracts. The frequency has been the same after percaine and after novocaine. The frequency of paresis of the bladder has been approximately the same after spinal as after general anaesthesia, which would seem to indicate that anaesthesia as such has not had any great significance. No disturbances of the functions of the anus or the rectum have been noted in the cases observed.

The symptoms observed can, a priori, be suspected to have been caused by injuries to the nerves. Vulnerability varies in individual cases and in a small percentage can possibly be so great that more long-lasting complications arise. Against this theory we have the fact that the frequency is greater in the group where percaine has been combined with inhalation anaesthesia. This has been especially frequent where spinal anaesthesia has not brought

about sufficient blocking, in other words where an increased resistance to the anaesthetic substance may have existed. We must, therefore, consider that the reason for these complications is uncertain. Possibly local arachnoiditis can have played a certain rôle. In the above-mentioned group, where a combined method of anaesthesia has been used, we find — according to the records of the anaesthetists — a large majority more than usually apprehensive of the operation to be performed.

### Symptoms from Parts of the Body Outside the Anaesthetized Area.

Diplopia has occurred as in the table below:

% of complications	< 1 week	> 1 week	> 2 weeks	> 1 month
SEBRECHTS .....	3.3	1.1	0.7	—
do. plus inhalation anaesthesia .....	0.8	0.4	—	—

After novocaine anaesthesia only one case of diplopia lasting more than 24 hours has occurred. Ocular motor muscle paresis has occurred practically without exception only after percaine and such combined with inhalation anaesthesia. Permanent injury has not occurred.

The theory mentioned above of a stretching of the abducent nerve by reason of the fact that the brain cannot "float on the liquid" appears untenable. In the first place, the specific gravity of the brain is higher than that of the liquid, and in the second place, if a falling backwards of the brain should cause such a great stretching in the abducent nerve a stretching in the pituitary stalk would also arise and this would appear to give rise to severe headache. These two symptoms do not occur concurrently. The abducent nerve appears, however, to be the most easily affected cranial nerve, for example in the case of variations of pressure and infections, and we have probably to seek the cause here, without being able to explain the mechanism more closely. Possibly post-operative fatigue can be accompanied by a weakness of accommodation, which is interpreted by the patient as diplopia.

Discomforts from the upper extremities alone have occurred as follows:

% of discomforts	✓ 1 week	✓ 1 month	✓ 2 months	✓ 6 months	✓ 1 year
SEBRECHTS .....	2.5	1.9	1.9	1.2	0.9
do. plus inhalation a....	1.0	—	—	—	—
SEMB .....	0.3	—	—	—	—
do. plus inhalation a...	—	—	—	—	—

Of these cases  $\frac{1}{10}$  have had discomfort from the ulnar region, the remainder without definite localization.

It is not possible to relate all these complications to spinal anaesthesia, but we must consider that they are caused by pressure on the nerves during or after the operation. In favour of this theory we have the lower frequency of sequelae from parts of the body where the anaesthetic has acted directly on the nerves, and also the definite localization to the ulnar nerve and especially its dorsal branch. The fact that occurrence has been more frequent in the case of percaine anaesthesia is probably due to the greater length of the operations, which means that the arm is subject to an unsuitable position for a longer period.

### *Summary:*

Such parts of the nervous system as are directly exposed to the anaesthetic in a certain concentration and during a certain period run, in a small proportion of cases, a small risk of trauma. As a rule the symptoms disappear rapidly, and it appears doubtful whether percaine and novocaine in the concentrations used can be held responsible for the discomforts. Symptoms can occur in the same, or even in a higher frequency, in the parts outside the zone directly affected by the anaesthetic. Symptoms from the upper extremities are probably caused by pressure on the nerves. Paresis of the ocular motor muscle is extremely rare and is always temporary. The most probable cause is a disturbance in the pressure of the spinal fluid.

The question of whether persons suffering from or having suffered from nervous diseases are more prone to complications and discomforts following spinal anaesthesia cannot be answered with certainty of the basis of the cases observed. Besides the case of haematomyelia mentioned, there were only four cases who had previously suffered from some organic nervous disease. Two had

had meningitis, one cerebro-spinal lues and in the fourth case a diagnosis could not be reached. One of the cases of meningitis — which was treated for fracture of the malleolus — suffered only from post-operative nausea for about two weeks. Duodenal ulcer was probably the cause, since the patient was some time later admitted to the hospital for this reason. The other meningitis case suffered from headache two months after the spinal anaesthesia. The patient who had suffered from lues and had earlier received malaria therapy, had headache before the operation and this persisted unchanged after the anaesthesia. The fourth uncertain case, treated for fracture of the malleolus, showed a certain weakness in the injured leg.

An additional small number of patients manifested other complicating illnesses: hypertonia, diabetes, uncertain nervous symptoms, rheumatic pains and vertigo. None of them appear to have been affected adversely by the anaesthetic.

### . Headache.

This is naturally a symptom which is strongly subjectively coloured and therefore difficult to assess. Frequency and duration are shown in the table below:

% of discomforts	1-3 days	1 week	∇ 1 week	∇ 1 month	∇ 2 months	∇ 6 months	∇ 1 year
SEBRECHTS.	13.3	8.7	4.7	1.5	0.9	0.3	0.3
do. plus in- halation a.	18.6	18.5	8.2	5.2	4.1	3.1	3.1
SEMB . . . .	10.2	5.1	2.3	0.3	—	—	—
do. plus in- halation a. 2/13 (15.4)	1/13 (7.7)	—	—	—	—	—	—

The cause of headache is, as has earlier been pointed out, much discussed. Cases of meningitis are rare, and the very slight meningeal irritation of chemical nature which occurs more regularly is too insignificant to be the cause.

BACKER-GRÖNDAHL considers, as mentioned previously, that the nervous constitution of the patient is the most important cause of headache. In the cases observed here, only six patients were diagnosed as seriously neurotic. Three of these had headaches

of short duration. Two others already suffered from headache before the anaesthetic, which did not intensify it. As can be seen from the table above, the frequency is highest in that group where spinal anaesthesia was combined with inhalation anaesthesia. The anaesthesia record shows that the majority of these patients were more than usually nervous before the operation.

Reduced cerebro-spinal pressure occurs in the great majority of cases after spinal anaesthesia. The various theories for this reduction have been named earlier. We do not appear to be able to discard the leakage theory on the grounds of the arguments brought forward hitherto. It has, for instance, been demonstrated that the dural hole can remain open for several days or weeks. In operations for herniated discs I have, after puncture of the exposed dura with a very fine needle, seen an abundant flow of spinal fluid in spite of the fact that the patient was prone and with his head lowered. Observations made when extracting a broken lumbar needle which lay in the dural sac parallel to the nerves in the cauda equina, point in the same direction. Here it was impossible to see the hole in the dura directly, but an abundant flow of fluid ran from the insignificant hole, despite the fact that more than a week had elapsed between the puncture and the extraction. During that time the patient had severe headache of which the flow of fluid was the most probable cause, since any signs of infections were absent. The fact that headache is not more common if a larger bore lumbar needle is used does not overthrow the leakage theory, since there is such a slight difference in the relative dimensions of the hole. Pressure variations in the cerebro-spinal system certainly play a larger rôle for the leakage than the diameter of the puncture.

No definite proof of the theories of other causes of liquid hypotension can be considered to be established.

Even if the origin of spinal fluid hypotension is the object of conflicting opinions, it appears to offer the most natural explanation of headache during the period immediately following spinal anaesthesia. The frequency is about the same as after lumbar puncture and it does not therefore seem reasonable to assume different causes for the origin of headache. Furthermore, the methods of therapy which aim at raising the fluid pressure produce satisfactory results. As the cause of headaches of longer duration it is probably necessary to assume constitutionally nervous predisposition.

In what way does the fall of cerebrospinal fluid pressure produce headache? SEBRECHTS *et al.* are of the opinion that the medulla oblongata is pressed down strongly and blocks the foramen magnum at the same time that a compensatory overproduction of fluid causes a rise of pressure in the cranial cavity thus accentuating the pressing down. This hypothesis appears improbable from several points of view. The first doubt which naturally arises in this connection is whether such a depression of the medulla oblongata can occur without more serious symptoms than the usual moderate headache becoming apparent.

If the experience of BACKER-GRÖNDAHL that migraine patients more often suffer from headache after spinal anaesthesia is compared with certain neuro-physiological research reported by ANTONI, it seems possible to arrive at a more reasonable explanation of headache after anaesthesia.

POHL, VON STORCH and LENNOX have demonstrated that during an attack of migraine the pressure in the cerebro-spinal space is, on an average, 40 mm lower than in the control cases. CLARK, HOUGH and WOLFF have found, by means of simultaneous photographic registration of the pulsations in the arteries of the skull and the fluid pressure, that the headache has commenced when the former pulsations increase.

If a disproportion arises between the inner and outer pressure on the arterial walls of the cranium, as is the case in spinal fluid hypotension, a possibility should exist of a stretching of the arteries during pulsation and this has been assumed to be the cause of migraine headache. A similar condition has been demonstrated in headache after injection of histamin (ANTONI). Since the same disproportion certainly arises in fluid hypotension after a spinal anaesthesia, it would appear possible to explain the subsequent headache in the same manner. An absolute identity with migraine headache is not assumed, since there are certain dissimilarities. Hypotension after spinal anaesthesia is stated to be greater than in an attack of migraine, and in the latter case a loss of tone in the artery wall can possibly be of greater primary significance. This explanation tallies well with the fact that headache does not occur during the anaesthesia but only after it has worn off, the blood pressure has returned to normal and the disproportion between this and the fluid pressure has had time to develop. This hypothesis is also the simplest

explanation of the fact that the headache is relieved or disappears when the patient is placed in a horizontal position.

The common occurrence that the frequency of headache is higher in the younger age-groups than in the older can most easily be explained by the above hypothesis, since the arterial walls are certainly less elastic in the latter and cannot, for this reason, be overstretched to the same degree as in younger persons.

In the cases observed, ordinary analgetics have given relief in the majority of cases where change of position alone has not sufficed. In no instance has serious headache been of such long duration that more complicated therapy has been considered necessary. In analogy with the above-mentioned hypothesis of the cause of headache, attempts have been made to relieve the former with ergotamintartrate (gynergen). No results are as yet available, but it would appear that this preparation has very satisfactory effects. It should be given at an early stage, before the headache has existed for any length of time, and in severe cases should be given in the form of injections. It is possible that it should be given prophylactically some hours after the operation and in repeated doses during the subsequent day or days.

### *Summary:*

Apart from rare cases of meningeal irritation, headache after spinal anaesthesia appears to be caused by spinal fluid hypotension, the most probable origin being leakage from the puncture hole. Headache appears to be best explained by an overstretching of arteries in the cranium owing to spinal fluid hypotension. In addition, constitutional nervous disposition must be assumed as a factor which increases the frequency, and which is probably responsible for headaches of longer duration. Spinal fluid hypotension can, however, even in such cases be the primary factor. Ergotamintartrate is recommended as a therapeutic measure.

### **Nausea and Vomiting.**

It is self-evident that nausea and vomiting are, in many cases, caused by primary illnesses, by a laparotomy or by morphine medication. Sufficient attention does not appear to have been given to such causes in the majority of previous publications. It is certainly impossible to form an opinion on how often spinal



anaesthesia as such is the cause of nausea and vomiting without surveying the material critically in some way. In the table below, the material has been grouped so that the first group consists of the total number of cases. In the second group all laparotomies have been excluded. Hernias of various kinds, even some strangulated hernias where there has been no reason to assume that the strangulation has caused vomiting have, however, been included in the second group.

*Total number of cases.*

	Duration	1 day	> 1 week	> 1 month	> 2 months
% of discomforts .....		8.7	1.8	0.15	—

*No laparotomy*

SEBRECHTS .....	4.0	1.3	0.7	—
SEMB .....	4.6	—	—	—

Nausea is less common after spinal anaesthesia than after inhalation anaesthesia, but is possibly of somewhat longer duration.

*Vertigo* has occurred as in the table below:

	% of discomforts	> 1 week	> 1 month	> 2 months
SEBRECHTS .....		1.5	0.3	—
do. plus inhalation a. ....		2.1	1.0	1.0
SEMB .....		0.6	—	—
do. plus inhalation a. ....		—	—	—

The vertigo of short duration which occurs with a fall of blood pressure during the administration of the anaesthetic has not been included. Vertigo which appears later is often connected with the position of the body and is, as a rule, relieved if the patient lies down. Furthermore it is often periodic and appears to occur especially in conditions of extreme fatigue. The largest number of cases belongs apparently to the last-mentioned group.

*Backache* has occurred as in the table below.

	% of discomforts	> 1 week	> 1 month	> 1 year
Tenderness at seat of injection .		0.3	0.15	—
Pain in the lumbar region .....		3.3	2.0	1.1
Pain in the scapular region ....		1.2	0.6	0.15

There is no difference between percaine and novocaine anaesthesia for the two first-mentioned localizations. Pain in the scapular region has only occurred after percaine anaesthesia or such combined with inhalation anaesthesia. All cases with this lo-

calization and a duration of more than one month comprised operations on the gall-bladder.

This symptom is such that a number of causes other than the anaesthetic can exist. Backache lacking definite objective symptoms occurs very frequently in our out-patients departments. Merely the fact of lying in bed can be the cause in a number of cases. An operation, especially a laparotomy, in addition to this means that we have other factors to take into consideration. It is not impossible that the spinal muscles can be over-stretched during operations or by lying in bed with the spinal muscles relaxed.

In order to determine whether the fall of blood pressure during a spinal anaesthesia can be of significance for late symptoms, of which no mention has been found in earlier literature, the patients have been divided into two groups, one with stated symptoms and one without. In the first group a fall of blood pressure to 70 mm or under has occurred in 30 %, and in 34 % in the group without symptoms. Arterial hypotension had remained in both cases for from 5 to 45 minutes. The fall in blood pressure does not, therefore, appear to have any importance for the causation of late symptoms. Otherwise it would have been assumed that a cerebral anoxia which arose with a pronounced fall in blood pressure, in spite of precautions being taken, could have been responsible for some of the discomfort.

Quite a number of patients underwent spinal anaesthesia more than once. It is naturally interesting to observe whether this fact carried with it an increased liability to post-anaesthetic complications, especially if the anaesthesia was repeated in a relatively short period. In the following table an attempt has been made to ascertain the relation of the complications to the number of spinal anaesthesias undergone. The complications have been divided, as objectively as possible, into slight and severe. Even very slight discomforts such as slight nausea or headache of one day's duration have been included in the former group.

Sebrechts	Total	Without compli- cations	Slight compli- cations	Severe compli- cations
1 anaesthesia . . . .	291	69 %	21 %	10 %
2 anaesthesias . . .	24	16/24 (67 %)	7/24 (29 %)	1/24 (4 %)
3 » . . .	4	4/4 (100 %)	—	—
4 » . . .	2	1/2 (50 %)	—	1/2 (50 %)
5 » . . .	2	2/2 (100 %)	—	—

Semb	Total	Without compli- cations		Slight compli- cations		Severe compli- cations	
1 anaesthesia ....	296	80 %		15 %		5 %	
2 anaesthesias ...	36	30/36	(83 %)	5/36	(14 %)	1/36	(3 %)
3 » ...	8	4/8	(50 %)	2/8	(25 %)	2/8	(25 %)
4 » ...	2	1/2	(50 %)	1/2	(50 %)	—	
5 » ...	3	2/3	(67 %)	1/3	(33 %)	—	
> 5 » ...	6	6/6	(100 %)	—		—	

BACKER-GRÖNDAHL appears to be of the opinion that the way in which the patient reacts to spinal anaesthesia is predetermined and that he reacts in the same way to repeated anaesthetics as to the first one. Practically nothing occurs in the present material which contradicts this opinion. Only two patients have stated that they have had discomforts for the first time after repeated anaesthesia. One of them had been anaesthetized twice, the other four times without any discomforts following the first two anaesthesias. The table above does not give any positive support to the suspicion that several anaesthesias repeated at short intervals give rise to more complications than the first. A repetition of spinal anaesthesia on one patient does not, therefore, appear to constitute increased risks.

In order to ascertain the dependence of the complications on the kind of anaesthetic substance used, the frequency of sequelae for all percaine and novocaine anaesthesias has been calculated. In the percaine group 69 % have been entirely free from complications, 21 % have experienced slight discomforts and 10 % more severe. In the novocaine group 80 % have been entirely free from discomforts, 15 % have experienced slight discomforts and 5 % more severe. It can be observed that the frequency is slightly higher for the percaine than for the novocaine group, although the difference is quite slight. This can certainly be explained, without becoming guilty of too uncertain conclusions, by the fact that the former group has been liable to greater general affection by reason of the more major operations performed. DOMRICH's observation that percaine is more toxic than novocaine is possibly correct, but in the concentration in which it has been used in the cases examined, any difference in toxicity has not been demonstrated conclusively.

In order to attempt still further to determine the question of the significance of toxicity in post-anaesthetic complications, calculations have been made of the doses used of the respective

anaesthetic substances, with the same division of the patients into those free from complications, with slight discomforts and with more severe. The average percaine dose given to those free from discomforts was 13 cc, 15 cc. to those suffering slight discomforts and 16 cc to those with more severe. The average calculation of the percentage of error shows that the differences in dosage are not certain and since they are, moreover, so slight, they cannot reasonably be assumed to have had any significance for the origin of the symptoms.

In novocaine anaesthesias there was no difference in the dosages in the three groups.

### Conclusions.

It must, as a general principle, be established that a satisfactory form of anaesthesia should have few or no contra-indications. Spinal anaesthesia appears in an increasing degree to fulfil this condition. The opinions as to contra-indications have been generally revised during the past few years.

In the case of patients with cardiac defects, arterial hypertension or poor general condition on account of their illness, and who are consequently poor operation risks, spinal anaesthesia should, in the majority of cases, be the most lenient form of anaesthesia especially in the case of major abdominal operations.

Shock should presumably be a contra-indication for spinal anaesthesia. Perforated ulcers and extra-uterine pregnancies can, however, advantageously and without risk be operated under fractional percaine anaesthesia.

During pregnancy, sensitivity to spinal anaesthesia should be an indication of a certain restraint and increased cautiousness.

Cases having a history of earlier neurological disturbances should still be in a category by themselves, since certain risks must be counted on if spinal anaesthesia is to be used. Whether spinal anaesthesia should be used in the case of nervous patients must be decided in each individual case.

Apart from these few contra-indications, spinal anaesthesia has gained an increasingly wide field and should be the ideal form of anaesthesia in many operations, *e. g.* ileus, peritonitis, icterus and uremia.

No difference in toxicity between percaine 1 : 1,500 and novocaine 5 % appears to exist.

The drawbacks attached to spinal anaesthesia have been ventilated, and in particular certain late symptoms must be counted as a definite disadvantage, but compared to the advantages of spinal anaesthesia these drawbacks must be considered as small. It is worth pointing out that other forms of anaesthesia also occasion late discomforts, although these have not been observed and discussed to the same degree.

### Summary.

The aim of this paper is, by a study of existing literature and the examination of 784 cases where spinal anaesthesia has been used, to form an opinion on the risks and post-anaesthetic complications in this connection. The anaesthetic substances used were percaine 1 : 1,500 and novocaine in 5 % solution. In one case of haematomyelia which resulted in death, anaesthesia must be considered to be the deciding factor. No other fatal cases have occurred in which the anaesthesia could be considered responsible.

Nervous symptoms from the anaesthetized zone have occurred in the form of paresthesia in 0.9 %. The longest duration was a little over six months with a frequency of 0.3 %. Paresis of the bladder occurred in 1.7 %. The maximum duration was 10 days. A toxic injury caused by the anaesthetic substance is considered to be an unlikely cause of complications. Nervous symptoms outside the anaesthetized zone were more common than the symptoms described above. Diplopia occurred in 3.3 %, all reversible. Nervous symptoms from the upper extremities occurred in 2.5 %, of which 0.9 % persisted for more than a year. They are considered to have been caused by pressure on nerves.

Headache occurred in 10—13 % with short duration, 5—9 % with a duration of more than one week, and in 0.3 % of over one year. Spinal fluid hypotension is assumed to be the cause of the headaches of short duration. This arises through a leakage of spinal fluid, which causes a disproportion between the arterial and the spinal fluid pressure and brings with it an increased stretching of the arterial walls in the cranium. A nervous constitution predisposes headache and is considered to be responsible for head-

aches of long duration. In cases resistant to ordinary analgetics ergotamine tartrate is suggested as a therapeutic measure.

Nausea was less frequent than after inhalation anaesthesia. Vertigo was of short duration and relatively insignificant. Backache has occurred in a maximal 3 %, most often after gall-bladder operations and is possibly due to overstretching of the spinal muscles. The fall in blood pressure during spinal anaesthesia has had no relation to the late symptoms. Repeated spinal anaesthesia at short intervals does not increase the risks or the frequency of post-operative complications.

69 % of patients were entirely free from discomforts after percaine anaesthesia, slight discomforts occurred in 21 %, more severe in 10 %. After novocaine anaesthesia the figures were 80 %, 15 % and 5 % respectively. Since those in the percaine group underwent more major operations, no difference in toxicity appears to exist. The quantity of the anaesthetic substance used has played no rôle for the causation of the discomforts. Novocaine 5 % and Percaine 1:1,500 are not so toxic as to couple their use with any notable risks. Spinal anaesthesia is a very satisfactory form of anaesthesia which has, however, a few contra-indications, *i. e.* certain conditions of shock and nervous diseases. Otherwise, in major operations in the abdomen or the lower extremities, spinal anaesthesia is superior to inhalation anaesthesia. Late symptoms following spinal anaesthesia are not of such importance that they indicate a restriction in the use of this form of anaesthesia.

### Zusammenfassung.

Die Arbeit bezweckt, durch Literaturstudien und Untersuchung von 784 Spinalanästhesien zu einer Auffassung von den Gefahren und Spätbeschwerden bei dieser Betäubungsform zu gelangen. Als Betäubungsmittel wurden Percain 1:1,500 und 5 %-ige Novocainlösung verwendet. Bei einem Hämatomyeliefall mit tödlichem Ausgang dürfte die Anästhesie als auslösender Faktor anzusehen sein. Im übrigen ist kein Todesfall vorgekommen, für den die Betäubung hätte verantwortlich gemacht werden können. Nervensymptome im Anästhesiegebiet in Form von Parästhesien kamen in 0.9 % vor. Ihre längste Dauer war reichlich 6 Monate

mit einer Häufigkeit von 0.3 %. Blasenpareesen kamen in 1.7 % vor. Ihre maximale Dauer war 10 Tage. Eine toxische Schädigung durch das Anästhetikum als Ursache der Beschwerden dürfte unwahrscheinlich sein. Häufiger als die oben besprochenen Symptome kamen Nervensymptome ausserhalb des Betäubungsgebietes vor. Doppelschen trat in 3.3 % auf, immer reversibel. Nervensymptome an den oberen Extremitäten sind in 2.5 % vorgekommen, darunter in 0.9 % mit einer Dauer von über einem Jahr. Sie werden als durch Druck bedingt angesehen.

Kopfschmerzen von kurzer Dauer sind in 10—13 % vorgekommen, in 5—9 % mit einer Dauer von über einer Woche. Mit einer Dauer von über 1 Jahr in 0.3 %. Als Ursache der kurzdauernden Kopfschmerzen wird eine durch Liquorleckage bedingte Liquorhypotonie angenommen, die ein Missverhältnis zwischen dem Arteriendruck und dem Liquordruck verursacht, was zu stärkerer Dehnung der Arterien bei den Pulsationen führt. Nervöse Konstitution disponiert zu Kopfschmerzen und wird für langdauernden Kopfschmerz verantwortlich gemacht. Als Therapeutikum bei gegen gewöhnliche Analgetika resistenten Fällen wird Ergotamin vorgeschlagen. Übelkeit kam weniger häufig vor als nach Narkose. Schwindel ist von kurzer Dauer und verhältnismässig unbedeutend gewesen.

Rückenschmerzen kamen in höchstens 3 % vor, zumeist nach Gallenoperationen, und waren vielleicht durch Überdehnung der Rückenmuskulatur bedingt. Das Sinken des Blutdruckes während der Spinalanästhesie stand mit den Spätbeschwerden in keinem Zusammenhang. Innerhalb kurzer Zeit wiederholte Spinalanästhesien bringen keine Vermehrung der Gefahren oder der Häufigkeit der Beschwerden mit sich. Völlig beschwerdefrei nach Percainanästhesie waren 69 %, leichte Beschwerden kamen in 21 % vor, schwerere in 10 %; nach Novocainanästhesie waren die Zahlen 80 % bzw. 15 % und 5 %. Da an der Percaingruppe grössere Eingriffe vorgenommen wurden, scheint kein Unterschied der Toxizität vorzuliegen. Die Menge des Betäubungsmittels war für das Auftreten der Beschwerden belanglos. 5 %-iges Novocain und Percain 1 : 1,500 sind nicht so stark toxisch, dass ihre Verwendung mit nennenswerten Gefahren verbunden ist.

Die Spinalanästhesie ist eine sehr gute Betäubungsform, die jedoch einige wenige Kontraindikationen hat, nämlich gewisse Schockzustände und Nervenleiden. Im übrigen ist die Spinalanästhesie bei grösseren operativen Eingriffen im Bauche und an

den unteren Extremitäten der Allgemeinnarkose überlegen. Die Spätbeschwerden nach Spinalanästhesie sind nicht von so grosser Bedeutung, dass sie eine Beschränkung der Verwendung dieser Betäubungsform motivieren könnten.

### Résumé.

Le travail a pour but de donner une idée des risques de la rachianesthésie et des troubles qui peuvent lui faire suite, en s'appuyant sur des recherches bibliographiques et l'analyse de 784 anesthésies de ce type. Les produits employés étaient des solutions de Percaine à 1 : 1,500 et de Novocaïne à 5 %. Dans un cas d'hématomyélie à issue fatale la rachi doit sans doute avoir été le facteur déclenchant. Par ailleurs il n'est survenu aucun cas de mort imputable à ce mode d'anesthésie. Des symptômes neurologiques dans le territoire anesthésié sont apparus sous la forme de paresthésies dans 0.9 % des cas. Le temps le plus long pendant lequel ils aient persisté a été de 6 bons mois, cela dans 0.3 % des cas. Des parèses vésicales ont existé dans 1.7 %. Leur durée maximum a été de 10 jours. Il est peu vraisemblable qu'une lésion toxique, due à l'anesthésique, ait été à l'origine de ces troubles. Les symptômes nerveux localisés en dehors du territoire anesthésié ont été plus fréquents que les précédents. De la diplopie est apparue dans 3.3 % des cas et a toujours été réversible. Des symptômes nerveux des extrémités supérieures ont été observés chez 2.5 % des malades, et dans 0.9 % des cas ils ont persisté plus d'une année. L'auteur les attribue à de la compression.

Des céphalées de courte durée ont existé dans 10—13 % des cas, et dans 5—9 % elles se sont prolongées au-delà d'une semaine. Dans 0.3 % elles ont continué pendant plus d'une année. On estime que la cause des céphalées peu persistantes réside dans une hypotension du liquide céphalo-rachidien, due à sa fuite par le trou de ponction, fuite qui provoque un déséquilibre entre la pression artérielle et celle du liquide C. R., et entraîne une distension de la paroi des artères à chaque pulsation. Une constitution névropathique prédispose aux céphalées et est considérée comme responsable de leur longue durée. L'ergotamine est proposée comme remède dans les cas qui résistent aux analgésiques



courants. Les nausées ont été moins fréquentes qu'après la narcose. Les vertiges durèrent peu et furent relativement insignifiants.

Les douleurs de dos sont apparues dans tout au plus 3 % des cas, le plus souvent après des opérations sur les voies biliaires, et il est possible qu'elles aient été déclenchées par la surdistension de la musculature dorsale. La chute de la tension artérielle pendant la rachianesthésie n'a pas été en corrélation avec les troubles tardifs. La répétition de la rachi à courts intervalles n'augmente ni ses risques ni la fréquence des troubles. Après l'anesthésie à la Percaïne 69 % des cas ne présentaient aucun trouble, 21 % des troubles légers, et 10 % des séquelles plus graves; après celle à la novocaïne les chiffres correspondants sont de 80, 15 et 5 %. Etant donné que le groupe de la Percaïne comprend les malades soumis à des interventions plus importantes, il ne semble pas exister de différence de toxicité entre les deux produits. La quantité de l'anesthésique n'a pas joué de rôle dans l'apparition des troubles. Ni la Novocaïne à 5 % ni la Percaïne à 1 : 1,500 ne possèdent une toxicité telle, que leur emploi soit grevé de risques notables.

La rachi est un très bon procédé d'anesthésie, qui a cependant quelques rares contre-indications, à savoir certains états de shock et certaines affections du système nerveux. Par ailleurs, elle l'emporte sur la narcose générale dans les opérations abdominales importantes et dans celles sur les membres inférieurs. Les troubles tardifs qui peuvent lui succéder ne sont pas d'une signification suffisante pour être un motif de restreindre son emploi.

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## A Case of Double Bladder.

Remarks on My Earlier Work of the Same Title.

By

ERLING F. HJORT.

In *Acta Chirurgica Scandinavica*, Vol. XCIV 1946, p. 262 I have described a case of double bladder under the above mentioned title. In this article I have mentioned a case reported by C. A. LJUNGGREN in "*Nordisk Medisinsk Archiv*" 1897, Vol. 29, No. 9, p. 1—21. It has escaped my attention that OLOF ODÉN in an article titled "*Ein Fall von Ectopia renis mit Hydronephrose und karzinomatöser Degeneration*" in *Acta Chirurgica*, Vol. LXXXI 1939, p. 425—438 has pointed out that this case described by C. A. LJUNGGREN in reality represented an ectopic and hydronephrotic pelvic kidney with carcinomatous degeneration. The patient was without symptoms after 40 years admitted to "*St. Görans Sjukhus*", and was here reoperated by Professor A. TROELL. For details reference is made to the above mentioned work by ODÉN.

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From Ludvika Hospital.  
(Head: HERMAN WAHREN, M. D.)

## Total Resection of the Carcinomatous Stomach.

By

HERMAN WAHREN.

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The familiar clinical picture of gastric carcinoma is that of a disease in an advanced stage. We know that potential or actual carcinoma may exist with little or no indigestion, without loss of appetite and without an-acidity and similar symptoms. Only in exceptional cases have we a chance to operate in early stages of the disease. Undoubtedly, this is one of the reasons for the bad results of surgery even in the most competent hands. Perhaps another reason lies in the fact that our operative methods are in many cases lacking in radicality.

The first total gastrectomy was performed by CONNOR in 1883. His patient died a few hours after the operation. The first successful case was described by SCHLATTER in 1897. This patient survived the operation one year and 53 days and died of metastasis in the liver. In the following year, two American surgeons, BRIGHAM and HARVIE, operated on two successful cases. In 1907, MOYNIHAN gave a vivid description of the technique of the operation and published one successful case of operated "leather-bottle stomach". His patient eventually died from pernicious anaemia.

After MOYNIHAN's paper, a great number of cases were reported in rapid succession and, in 1928, FINNEY and RIENHOFF were able to collect 67 cases from literature in which the rate of mortality was 53.8 %. ROEDER, in 1938, recorded 91 cases with a mortality of nearly 50 %. LAHEY has discussed the technique of the operation in a paper from 1938 and published 27 cases, in 1940,

with 7 fatalities. In 1945, JONES and KEHM reported 8 consecutive cases without death.

All the above-mentioned authors have used the transperitoneal approach to the cardiac end of the stomach. HEDBLOM, GARLOCK and others have performed combined transpleural and transperitoneal resections of the cardia and the lower oesophagus. Naturally, this technique is of the greatest value, if the tumour is situated at the cardia or in the lower end of the oesophagus, but it is not necessary in the case of intraventricular tumours.

The first mention of total gastrectomy I have been able to find in Scandinavian literature appears in 1920, when HENRI SUNDBERG reports two cases. In 1927, TROELL, LOSELL and KARLMARK reported two cases, one of which was thoroughly investigated a couple of months after the surgical intervention on behalf of the digestive function. HOLST has been greatly interested in the radical treatment of gastric carcinoma. He performed total resection in 12 cases, with 4 post-operative fatalities. In selected cases, he leaves a "cardiac ring" which, in his opinion, facilitates the suture between the oesophagus and jejunum and strengthens it. In a paper from 1937, LANDELIUS discusses his results with partial and total resection and is generally in favour of the more radical procedure. S. LUNDBERG has published a rather unique case of total resection with oesophago-duodenal anastomosis. In his patient, a leakage subsequently developed, the healing of which could be followed in the radiograms. STRÖMBECK, in 1944, has reported a case of a carcinoma in the medial part of the fornix, with resection of the oral two thirds of the stomach. This case also showed signs of insufficiency of the suture line, resulting in a limited inflammatory process in the adjacent tissue and in bacterial pleural exsudate. Other contributors to Scandinavian literature are INGEBRIGTSEN, GREVILLIUS and RÖDÉN.

The technique of gastrectomy has been discussed in detail by MONIHAN, LAHEY and, later, WALTON, HOLST, LANDELIUS and MAINGOT. All these perform an oesophago-jejunostomy with or without entero-anastomosis. There is no great difference in technique between these authors, but it is apparent from their work that good planning and most careful observation of technical details is of utmost importance for good results.

In their above-mentioned reports, FINNEY and RIENHOFF make an analysis of the causes of death in the fatal cases. The general mortality is approximately 50 % and the most common

cause of death is without doubt general peritonitis. A further analysis of the different methods of repair of the alimentary tract, revealed the fact that the oesophago-duodenal anastomosis rendered a higher mortality rate than the oesophago-jejunal method.

The examination of the effect of total gastrectomy on the digestive process was made early. The case, previously mentioned by SCHLATTER, of a patient who lived for more than a year after the operation presented normal conditions in the urine and faecal tests and was, at the time of examination, in a good state of nutrition. More comprehensive examinations regarding metabolism have been made by TROELL and his collaborators and by GADE on HOLST's material. WALTON has also studied fluid balance and metabolism in one of the cases operated by him. It can be said about all these cases that only an insignificant deviation from the normal could be discovered.

The conditions are somewhat different regarding the haemato-poietic function of the organism after total gastrectomy. In certain cases we find a clinical picture of the disease which is reminiscent of pernicious anaemia. Accounts of such cases are published by MOYNIHAN, HARTMAN, POOLE and FOSTER, UNGLEY and others. In these cases, however, it cannot be precluded with any degree of certainty that undiagnosed cancer metastasis has had a causative significance in the existing blood changes. It would seem that the specialists are not in full agreement regarding this question. It is usual, however, that anaemia of a secondary type occurs after total resection of the ventricle. These cases usually react well to iron medication.

It may be said summarily, that persons who have been deprived of their stomach are more or less disabled, although they are able to lead a fairly tolerable life.

### Indications.

It is evident, *a priori*, that in many cases the partial resection does not fulfil, by far, the theoretic demands for radical treatment of a cancerous process. EKER and before him BORRMAN have both shown that the macroscopic inspection and judgement of the spreading of a ventricle cancer is very unreliable. Tumour infiltrations can be found as far as 5 cm from the palpable tumour

in macroscopically fully free tissue. In 22 of the 59 cases examined, EKER found tumour infiltrations in the resection line.

Even removal of the lymphatic gland system of the ventricle is not satisfactory in partial resection. EKER found lymphatic gland metastasis in 36 % of the 181 cases examined. Considerably higher figures were discovered by COLLIER, KAY and MCINTYRE who diagnosed tumour changes in 75 % of 53 cases. These authors also state that, even though one can establish a certain correspondence between the place of the primary cancer and the affected lymphatic glands, there are nevertheless many exceptions to this rule in that small tumours on either curvature of the stomach could involve nodes along the opposite curvature.

Total resection of the ventricle is therefore indicated for tumours within the fundus and within the upper portions of the corpus where one cannot obtain a space of at least 5 cm of healthy tissues from the cardia. The indication for total resection is further accentuated by the fact that the adeno-carcinomatous tumours within this space are often relatively non-malignant, especially when situated at the major curvature (EKER, SÖDERLUND). The more uncommon cases of scirrhus changes which often spread over a large part of the ventricle are likewise suitable objects. In these cases the ventricle is often shrunken with an elongated oesophagus which facilitates the operation.

With regard to radicalism in the matter of removing the lymphatic gland system, a certain resignation might be in place, even in a radical operation. The mere fact that the tumour, by passing over the local glands, can metastasize directly into the glands around the aorta, forces one to a certain pessimism. In the cases which I have operated, I have endeavoured to protect the ascending branch of the arteria gastrica sinistra, which lessens the possibility of effectively removing the cardiac glands.

Among Swedish surgeons, LANDELIUS and RÖDÉN have discussed the question as to whether all operable ventricle tumours in patients in a good condition should not be treated by radical resection, which seems to be a problem worthy of consideration.

### Technique.

Previous experience shows that without doubt the most usual cause of death after total gastrectomy is peritonitis which most surely must be supposed to originate in the anastomosis between

the oesophagus and the jejunum and /or the duodenum. In this respect, the cases of LUNDBERG and STRÖMBECK mentioned above are interesting, as they show signs of sutural insufficiency in the anastomosis, although the final result was satisfactory. The technique must therefore aim at trying to bring about the establishment of an anastomosis as aseptically as possible and to create good nutritive conditions in the connection. It is decidedly more advantageous to join the oesophagus to the jejunum, as this part of the intestines, hitherto untouched by the operation, possesses better circulatory conditions and can more easily tolerate the stretching, which must take place in order to bring about an anastomosis. Further, the ascending branch of the arteria gastrica sinistra should be protected as well as possible, since the lower portion of the oesophagus is dependent to a high degree on this vessel for its nourishment. The general nutrition must also be cared for during the first days after the operation, as one dare not give nourishment per os. The modifications which have been made on the usual technique are based on these considerations.

Prior to the operation, the patient has lain in hospital from 1 to 4 weeks. During this time blood transfusions have been given, cariated teeth extracted and achylous patients have been given hydrochloric acid.

*Anaesthesia.* Fractional percain lumbar anaesthesia + narcotal, under certain conditions + ether and nitrogen monoxid. 20—40 cc 1 % novocain around cardia.

From the beginning, the surgeon places himself on the left side of the patient. Strait incision, parallel with the left lower costal margin. Removal of the omentum majus begins high up on the major side and continues towards the pylorus at a distance from the wall of the ventricle. The ligamentum gastrocolicum is detached close along the colon transversum. The duodenum is dissected, divided and invaginated in the usual manner. The omentum minus is now divided as far to the right as possible right up to the cardiac region. The operator can now conveniently pass over to the right side and detach the region of the fornix. It should then be remembered that some of the larger veins from the region of the splenic vessels can communicate with the ventricular vessels. I have never encountered any vessels of importance within the region of the fornix to the left of the oesophagus. Therefore this part can be detached by obtuse dissection by hand and without the help of the eye. Subsequently, one identifies the oesophagus



on the major side and divides the left vagus. After this the peritoneum, which passes over from the dome of the diaphragm to the cardia, should be divided by scissors on both the anterior and posterior sides. The cardia in its entirety is now much more mobile.

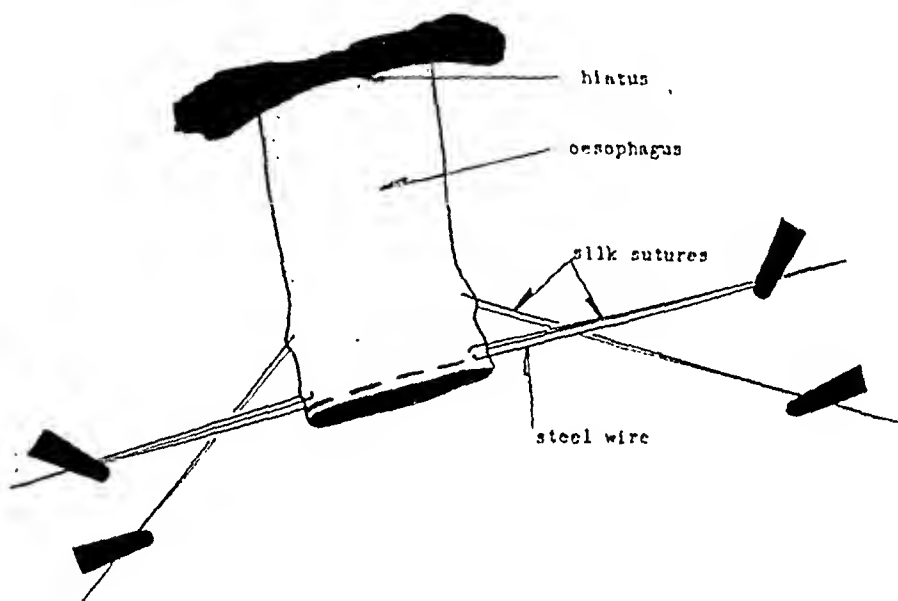


Fig. 1. The cut end of oesophagus closed by steel wire held extended by silk sutures. Another pair of temporary guide silk sutures are inserted 1 cm. above in order to facilitate the introduction of the posterior rows of sutures.

Standing on the left side of the patient the operator should now try to identify the arteria gastrica sinistra and the cardia-oesophagus on the minor side. It is often easy to identify the vessel and follow it up to the wall of the ventricle where it is divided *whilst protecting the ascending branch*. Afterwards, the right vagus nerve, which stretches during traction, is divided.

The oesophagus can now be pulled down several centimeters. One should, however, be careful not to use too much force when drawing the organ down. A running wire (GARPENBERG's twined steel wire) is now zigzagged through the lower end of the oesophagus, closing the lumen, and a fine silk suture placed on both right and left edges, holding the lumen stretched on the wire, as shown in the picture. In order to facilitate the insertion of the posterior rows of sutures which takes place at a later stage of the operation, two silk sutures can be placed somewhat higher up on the

oesophagus (see pictures). The oesophagus is now divided by diathermy.

A longitudinal incision is now made in the drawn-up coil of the jejunum through the tunica muscularis in order to mark the

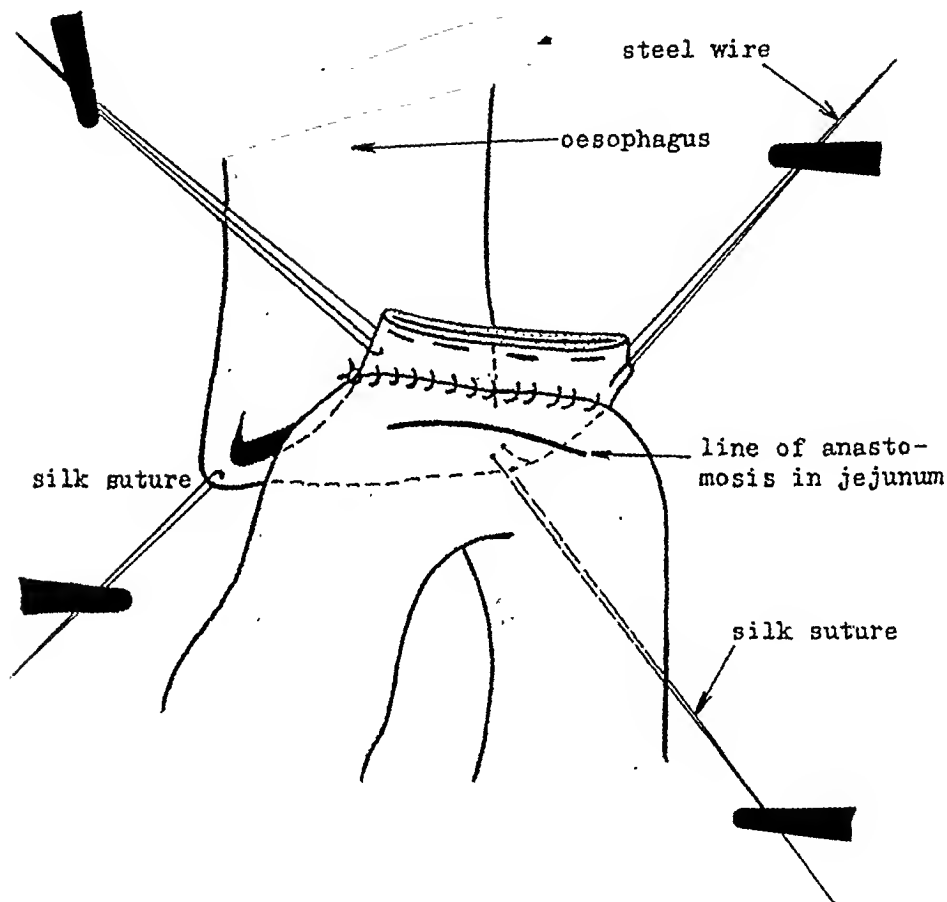


Fig. 2. Figure showing first row of posterior of catgut stitches in place. The cut end of oesophagus elevated forwards and upwards.

line of anastomosis. After this, two rows of either isolated or, if possible, continuous catgut sutures are sewn on the posterior side. The jejunum is opened with diathermy in the previously made incision and the anastomosis is sewn on the anterior side as well. The steel wire is withdrawn and, if possible, the jejunum is fixed to the diaphragm. It is not always possible to do this, however, on account of the position of the left lobe of the liver and, for that matter, it is not even necessary. A long entero-anastomosis is subsequently sewn between the coils.

The average time for the operation is approximately two and a half hours.

After the operation blood transfusion together with intravenous aminosol infusions have been given. The patient has begun to drink on the fourth or fifth day.

### Comments on technique.

The importance of preoperative treatment need not be especially emphasized. It is a usual experience that patients with cancer ventriculi can revive as the result of a thoroughly well carried out invigorating treatment in which blood transfusions are the most important auxiliary.

The incision under the edge of the left rib usually gives sufficient approach; only in one case have I mobilised the left rib in accordance with MARWEDEL, a procedure which somewhat improved the operative possibilities.

Care of the vessels round the cardia and the abdominal part of the oesophagus is of especially great importance when planning the operative technique. The lower part of the oesophagus is cared for partly by the ascending branch of the arteria gastrica sinistra and partly by the arteriae phrenicae inferiores. The ascending branch of arteria gastrica sinistra is not constantly encountered. In 2 cases out of 12, I was not able to find any distinct ramus ascendens when examining the corpse. In these two cases, however, the left art. phren. inf. was more developed. Another anatomic detail which is of great importance for the operation is the course of the lower part of the oesophagus. The abdominal part of the oesophagus lies somewhat folded and, after cutting through the peritoneum on the anterior and posterior sides, can be lengthened by several centimeters. During examination of the bodies of deceased elderly patients, I was able in one case, after cutting through the peritoneum, to elongate the oesophagus 6—7 cm without exercising too much traction. This ought to be the maximum lengthening. The thoracic part of the oesophagus is fixed, which makes any increased traction useless; it only causes damage to the circulation. Section of the trunks of the vagus usually increases elongation by several centimeters which is mentioned by NYSTRÖM in his work on the treatment of stenosis of the cardia. No functional changes which could be connected with this section of the nerve have been observed.

Suturing of the anastomosis is greatly facilitated by the arrangement with the steel wire which also effectively blocks the oesophagus during the placing of the sutures.

In my opinion the administration of aminosol (3.3 % solution of aminoacid and polypeptids + glucose) during the immediate postoperative period is of importance to these patients, often in poor condition, as one does not dare to take the risk of giving nourishment to the patient through the oesophagus. The disadvantage is that thrombophlebitis accompanied by a rise in temperature easily occurs in the veins at the point of infusion. The establishment of a jejunal fistula in order to solve the problem of nutrition carries, in my opinion, a considerable risk for peritonitis in those patients.

Some American authors consider that extirpation of the spleen ought to be performed simultaneously with total ventricle resection. I find it difficult to see any rationality in such a step, nor have I in any case resected the omentum majus.

### Casuistics.

961/40. L. K. 69 years. M. Stomach trouble for 15 years. Lost weight considerably during recent months. Rtg: An irregular contour within the upper part of the corpus on the major side which reappears in all radiographs. Operation: Gastrectomy with retention of "the cardiac ring". A large tumor was found within the fundus, involving chiefly the major side. Progress without comment. Lived  $4\frac{1}{2}$  months after discharge from hospital. Cause of death: Pneumonia(?).

1831/44. K. E. A. 43 years. M. Stomach trouble for half a year. Rtg: Infiltrative process within the corpus with irregular contour on the major side. At operation, a widespread infiltration within the upper part of the corpus with walled ulcer. The histological examination showed a carcinomatous, degenerated ulcer within the upper part of the corpus on the major side. Progress without comment. Died 4 months after operation from metastasis in the liver.

1385/44. E. J. 48 years. M. Stomach trouble for 8 months. Rtg: Infiltrative process within the canalis which extended above the angulus on the minor side. At operation, a hard gland the size of a large dove's egg was discovered near the cardia for which reason a total resection was performed, despite the fact that the infiltration did not stretch farther than a few centimeters above the angulus. Histological examination: Cancer ventriculi with cancerous changes in the lymphatic gland. Progress without comment. Alive two years after the operation. Works in a factory as before the operation. Does not feel especially tired. Often eats once during the night. Normal blood value. Normal blood-sugar curve.

603/44. A. K. 64 years. F. Trouble for about one year. Lately considerable loss in weight. Rtg: Large filling defect within region of fundus, situated chiefly on the major side. Histological examination: Low, differentiated adenocarcinoma with widespread lymphatic metastasis. Progress without comment. Lived 14 months after discharge. Cause of death: Metastasis in the lymphatic glands and in the liver.

778/44. R. R. 55 years. M. Stomach trouble for past month. Rtg: Irregular contour within the region of angulus with infiltration of the lesser curvature. At operation, a large cancer within the corpus on the minor side which extended right up to the cardia. Histological examination: Cancer simplex solidus. Metastasis in the omental glands. Progress complicated by pneumonia. Lived 11 months after discharge. Cause of death: Metastasis in liver and glands.

663/45. K. E. S. 68 years. M. Stomach trouble for 4 years. Rtg: Infiltrative process within the fundus. At operation, a butterfly-shaped scirrhus infiltration within the fundus and corpus emanating from the minor side. Histological examination: Profusely mitotic cancer ventriculi, scirrhus in parts. Metastasis in the lymphatic glands. Process without comment. Lives in good health at a pensioners home almost two years after the operation. Has had anaemia at times but reacted well to iron and liver medication. Blood value at last examination: Hb 84 %. Red corpuscles 3.5 millions.

1537/45. K. A. B. 45 years. M. Stomach trouble for some months. Rtg: Irregular contour within the canalis. The infiltration extends over the angulus. At operation a cancer, involving the lesser curvature, which extended up towards the cardia was discovered. Hard nodes in the omentum minus. Histological examination: Cancer with large, atypical cells and a profusion of mitosis. No cancer tissues in the lymphatic glands. Progress complicated by thrombophlebitis from intravenous injections of aminosol infusions. Lives in good health and is fully employed. Shows normal blood value one year after discharge. Increase in weight after operation 4 kg.

1714/45. M. E. O. 69 years. M. Rtg: A rigid irregular wall contour with ulcer is found within the fundus on the major side. The operation showed a large, cauliflower-like tumor within the fundus extending from the fornix. Histological examination: Tumor with cancerous proliferations and large atypical cells and profuse mitosis. No metastasis in the lymphatic glands. Still living but has signs of metastasis in the liver 10 months after operation.

441/46. K. V. A. 59 years. M. Stomach trouble for some months. Rtg: A considerable filling defect within the medial region of the corpus. At operation, a polypous tumor about the size of a hen's egg was found within the medial region of the corpus, attached to the posterior side of the ventricle near the lesser curvature. Histological examination: Highly differentiated adenocarcinoma. No metastasis in the lymphatic glands. Progress complicated by thrombophlebitis from aminosol infu-

sions. The patient was readmitted to hospital on account of colitis which, however, disappeared after hydrochloric acid medication. Is still alive but does not work. Normal blood value. Normal blood-sugar curve.

Nine patients, eight men and one woman between the ages of 43 and 69 years, all suffering from cancer within the corpus portion of the ventricle, have been treated by total resection. All of them were discharged from hospital in good condition. One of these, however, when last examined, showed signs of metastasis in the liver 10 months after the operation. Two of them are fully capable of working, two are well but are not engaged in any work, they are 59 and 68 years of age respectively. Of the patients who are working, one has the same weight as before the operation and one has increased in weight by 4 kg. One 68-year-old patient has suffered periodically from anaemia of a primary type. The blood value has risen after medication with iron and liver preparations.

The first death occurred from metastasis in the liver 4 months after discharge from hospital. Three other patients died within a year after the operation. In one of these cases the cause of death was not possible to ascertain. In the first case a resection was performed according to HOLST's method with retention of "the cardiac ring". This procedure is less satisfactory from the point of view of tissue nourishment and, in my opinion, it does not facilitate the operation. In the other cases the oral line of resection has been placed above the cardia.

### Conclusion.

It is the opinion of the author that every surgeon who has carefully studied the technique of total resection of the ventricle need not anticipate a higher rate of mortality than that occurring in partial resection. The operation ought to be used for cancer in the fornix and within the upper portion of the corpus, as well as in certain scirrroid processes. As to whether all cases of cancer ventriculi should be treated by radical resection is doubtful. In principle this form of treatment is, of course, rational, but when one takes into consideration that every case of cancer within the stomach is diagnosed at a late stage, it is far too optimistic to expect decidedly better results. The surgeon's great opportunity will only come when the disease can be diagnosed in its pre-cancerous stage.

### Summary.

Nine cases of total resection without primary mortality are discussed. A thorough description of the operative technique, is given together with reflections on the vascular supply of the anastomosis.

### Zusammenfassung.

Verf. teilt neun Fälle von Totalresektion des Magens ohne primäre Mortalität mit. Die Operationstechnik wird eingehend beschrieben, und es werden Reflexionen über die Blutzufuhr zur Anastomose angestellt.

### Résumé.

L'auteur communique neuf cas de résection totale de l'estomac sans mortalité immédiate. Il décrit de façon détaillée la technique et se livre à des considérations sur la vascularisation de l'anastomose.

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## **Malignant Nasopharyngeal Tumours Manifesting Themselves as Parotid Tumours.**

By

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The past few decades have, through an ever increasing number of publications, disclosed an increased interest in the often surprising and polymorphous symptomatology of the malignant nasopharyngeal tumours, which so frequently gives rise to mistaken diagnosis and wrong treatment. As appears from these publications and most recently from a Danish monograph (GODTFREDSSEN 1944) the mistaken diagnoses can be grouped round certain signs and symptoms, partly ophthalmo-neurological, partly oto-rhinological, and partly from metastatic glands of the neck.

A rarer and more singular mistaken diagnosis has been met with in the *Finsen Institute* and *Radiumstationen*, where two cases have been observed of malignant nasopharyngeal tumours manifesting themselves as parotid tumours. The proper diagnosis was difficult to make in these cases. It is the object of the present paper to throw a light in this rare form of manifestation of nasopharyngeal tumours, of which no detailed description has been given before.

As a background for this statement it will be appropriate first to recapitulate in brief the clinical main points as regards both malignant nasopharyngeal tumours and parotid tumours.



## Symptomatology and Histopathology of Malignant Nasopharyngeal Tumours.

These subjects having been discussed recently in a monograph (GODTFREDSSEN 1944), mention will be made here chiefly of the facts that are of special interest in relation to the parotid tumours.

Malignant nasopharyngeal tumours are rare tumour forms, but not rarer than it has been possible to collect within the past decade 454 cases from our Scandinavian radiological clinics (GODTFREDSSEN).

The tumours, which arise from the mucous membrane and the submucous lymphoid tissue, may occur within all age-classes, and are found twice as often among men as among women.

*Histopathologically* the great majority are anaplastic tumours of low differentiation (squamous epithelial carcinomas and reticulum cell sarcomas). Tumours may arise also from the tubulo-alveolar, seromucous glands found in the nasopharyngeal mucous membrane. These mixed tumours of the salivary gland type are, however, of very rare occurrence. Thus there were found only 5 cases (all cylindromas) among GODTFREDSSEN's 438 histopathologically verified nasopharyngeal tumours.

In ARLBOM's monograph on the salivary gland tumours (1935) only one out of 254 cases was localized in the nasopharynx. RINGERTZ, in his dissertation (1938) on tumours in the nasal cavity and the paranasal sinus, has collected 37 cases of salivary gland types, among which only one was found in the nasopharynx. Of THERKELSEN's 78 salivary gland tumours (1934) none was localized in the nasopharynx.

*The clinical picture* presented by malignant nasopharyngeal tumours of the salivary gland type differs on no essential points from the symptomatology of the other tumour types. The patients present signs and symptoms brought about by the growth of the primary tumour itself, partly exophytically in the nasopharynx, and partly through the propagation to the adjacent regions (infra-temporal fossa and deep portion of retromandibular fossa) where the parotid area may be included. Invasion into the base of the skull will bring about trigeminal neuralgia, abducens paralysis, and other eye signs.

An important part of the symptomatology is due to regional uni- or bilateral metastases to the lymph nodes of the neck, pre-

ferably the superior, profound group behind the angulus mandibulae at the mastoid process inferior to the sternocleidomastoid muscle. The lymph may by a special course run primarily into the lymph nodes in the parotid gland and here give rise to a tumour formation manifesting itself as a primary parotid tumour.

When the exophytic growth of the nasopharyngeal tumour in the nasopharynx has reached a certain extent there will occur local signs in the forms of nasal stenosis, secretion and epistaxis. If the primary tumour arises from the area round the pharyngeal orifice of the eustachian tube, it will give rise to tubal occlusion (tinnitus, clicking sensation), and possibly signs and symptoms of otitis.

As the above briefly mentioned signs and symptoms may occur in different combinations and degrees, it will easily be understood that the symptomatology may be extremely polymorphous. The signs and symptoms develop, like in the cases of primary parotid tumours, partly through lymphogenic metastases and partly through the expansion of the primary tumour itself to the parotid.

Histopathologically the primary parotid tumours and the nasopharyngeal tumours present the same tumour types, a fact which renders difficult the diagnostication on the basis of biopsy of apparently primary parotid tumours.

### Clinical Signs and Histopathology of Parotid Tumours.

This subject has been discussed in greater detail in various Scandinavian works published within recent years: Two valuable, Swedish dissertations dealing with *Radiumhemmet's* cases (AHLBOM 1935, and RINGERTZ 1938) and THERKELSEN's prized, histopathological work (1934). It will, therefore, be sufficient here to recapitulate certain facts of particular interest in this connection.

The parotid tumours — like the nasopharyngeal tumours — are rare tumour forms. They constitute 1.2 % of the malignant cases in radiological clinics (AHLBOM).

*The clinical picture* is characterized by a more or less slowly increasing tumour in the parotid area. The tumour capsule is intact and the growth indolent in the benign forms, whereas the malignant tumours (25 to 30 % of the total number) penetrate the capsule and invade the subcutis and the surrounding tissue; and besides, through their invasion into sensitive and motor

nerves, they involve both painful trigeminal neuralgias and facial paralysis. Metastases to regional lymph glands (angulus mandibulae) occur in 20 % of the cases (AHLBOM).

*Histopathologically* the conditions are as yet far from clear, but the tumours are now classed in 3 categories: benign, semimalignant, and malignant. The pictures are extremely variegated with mixed forms of epithelial and mesenchymal elements, where metaplasia is often prevalent (THERKELSEN). Distinction is made between fibromyxoepithelioma and basalioma according to the predominant type of tissue. In case there are pronounced cystic cavity formations we speak of cylindromas.

Parotid tumours are to-day generally referred to a surgical department, where excision may be found opportune. The value of a preceding biopsy is limited, because the histopathology varies to such a great extent. That the question of primary or secondary tumour should be considered in cases of parotid tumours will appear from the following case histories.

### Case Histories.

*Case 1.* Case 21342, Radiumstationen. Woman aged 36.

2 years before reference there appeared at the *right* angulus mandibulae a steadily increasing, indolent node covering the lower portion of the *right* parotid area. A tumour intimately adherent to the vessels was excised with some difficulty in a surgical department. Postoperatively there occurred a slight facial paralysis.

*Microscopy* of tumour (Fig. 1): Malignant endothelioma of the type of mixed tumour in salivary gland (F. BANG).

The tumour recurred 6 months after the operation, and it was now associated with swelling of the posterior portion of the gingiva of the right lower jaw with painful trigeminal neuralgias. The gingival tumour burst spontaneously shortly before the reference, and pus was evacuated.

*On reference to Radiumstationen:* Paralysis of rt. abducens (of 4 months' duration), of masticator, and of facial nerve. A split, nodular, fixed tumour the size of a small apple found in the rt. parotid area and the retro-auricular region. No glandular tumour further down the neck. In the *nasopharynx*, a lobate, pink, submucous tumour was found arising from the posterior wall and the rt. lateral wall superiorly.

*Skiagram* of the base of the skull showed a large, osseous destruction on the right side comprising foramen lacerum, rotundum, and ovale (B. WÖRNING).

*Microscopy* of the nasopharyngeal tumor showed a picture (Fig. 2) corresponding exactly to that of the parotid tumour; and a *diagnosis* was made of cylindroma-like, atypical, salivary gland tumour arising

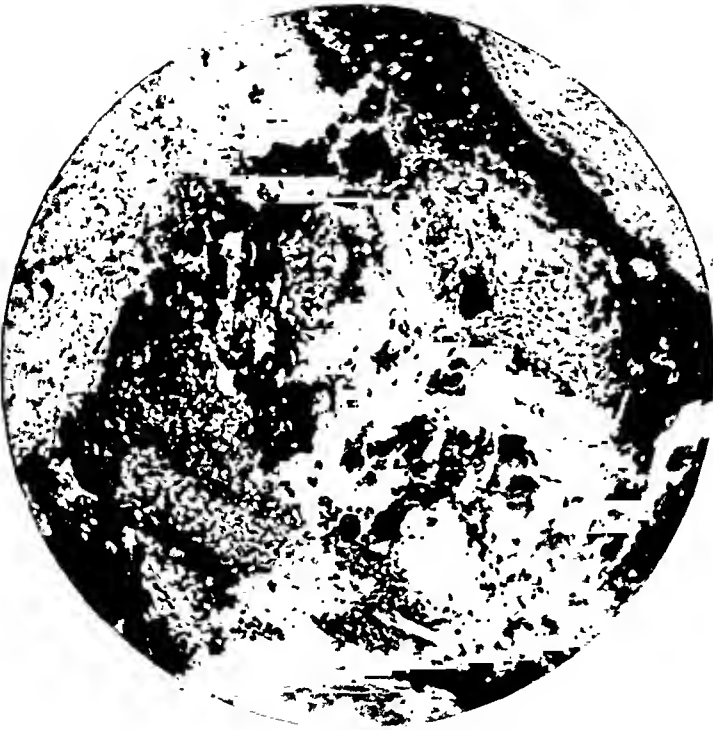
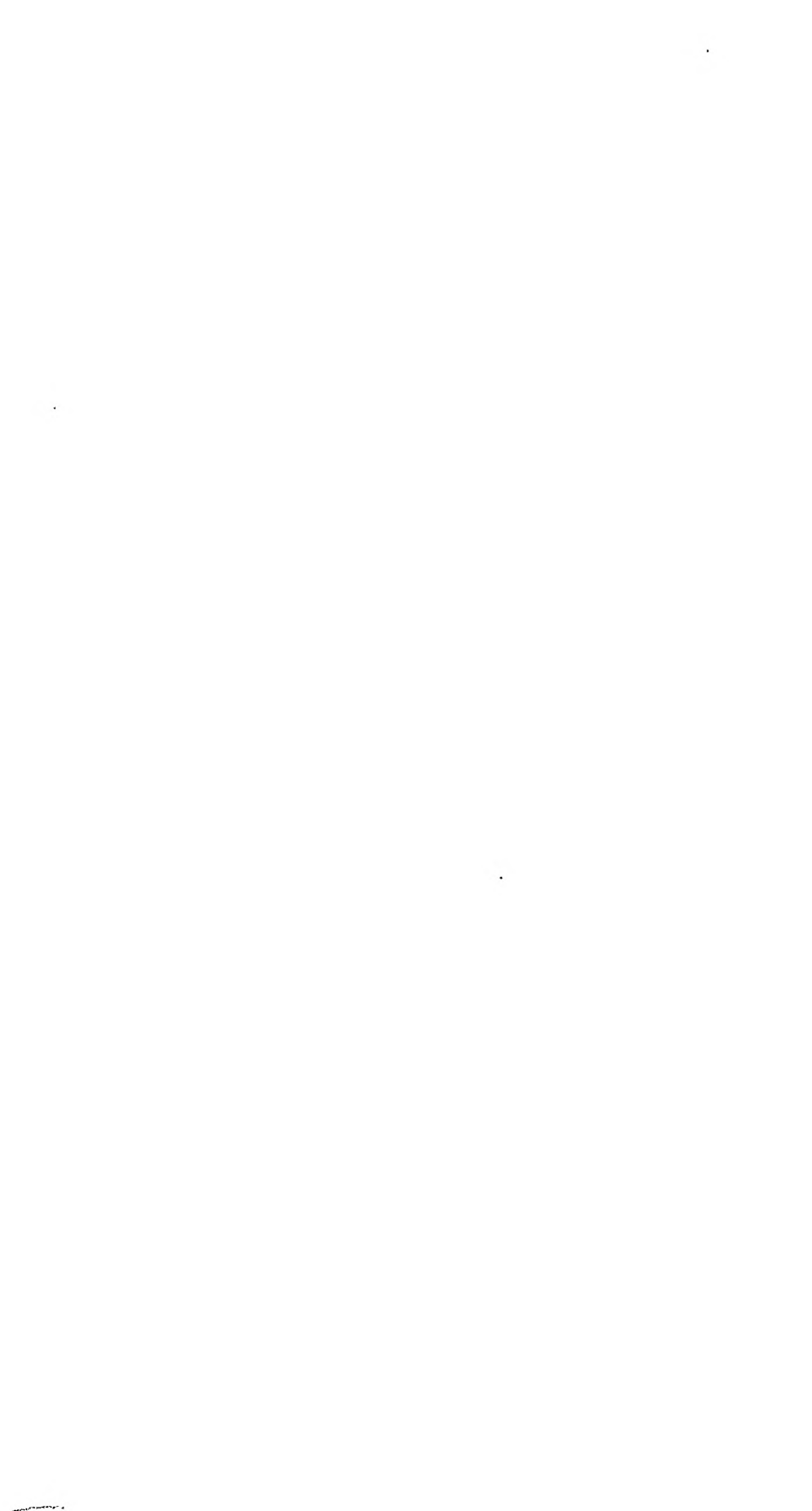


Fig. 1. Biopsy from excised tumour in the parotid gland (case 1) showing the variegated picture which characterizes a mixed tumour arising from salivary gland tissue.



Fig. 2. Biopsy from the primary tumour in the nasopharynx (case 1) of the same histopathological nature as Fig. 1. where the malignant mixed tumour of the salivary gland type presents chiefly the character of an endothelioma (atypical cylindroma).



from the nasopharynx with regional metastases to lymph glands in the rt. parotid.

A powerful *X-ray treatment* (7265 r. for 67 days) made the primary tumour and the pains subside, but complete freedom from symptoms was not obtained. Two years later the condition deteriorated with massive, intracranial tumour progression (rt. ophthalmoplegia, impairment of vision, exophthalmos, choked disc), and the patient died 2 years and 3 months after her reference.

*Epicrisis:* A woman aged 36 with a malignant, atypical cylindroma-like tumour (salivary gland type) in the nasopharynx, which had started with signs and symptoms from regional gland metastasis in the parotid gland. The tumour was diagnosed as a primary salivary gland tumour and was accordingly removed unradically, soon to recur. There was ingrowth into the base of the skull with lesion of the fifth and sixth cranial nerves. X-ray treatment brought about temporary improvement; but after some time there occurred progression and massive intracranial tumour invasion with death 4 years and 8 months after the diagnosis had been made.

*Case 2.* Case 23520, Radiumstationen. Woman aged 48.

3 or 4 months before reference the patient had developed a steadily increasing tumour of the *right* parotid gland. Excision was made in a surgical department of a greyish, soft tumour the size of a walnut, which extended deep into the retromandibular fossa.

*Microscopy* showed the tumour to be a reticulum-cell sarcoma (F. BANG), and the patient was referred for postoperative irradiation treatment.

On reference to the Radiological Clinic hardly 3 weeks after the operation recurrence was already ascertained. There was found in the right parotid area a diffuse, firm, elastic indolent tumour the size of half an orange, which was adherent both to the cicatrix and profoundly. No glandular tumour elsewhere. As no nasopharyngeal tumour could be demonstrated, neither rhinoscopically nor roentgenologically, the right parotid area was submitted to local X-ray treatment, and the tumour disappeared quickly.

One year later there occurred in the *left* parotid gland a tumour, which likewise disappeared promptly after X-rays.

After the elapse of another year a node was observed in the left supraclavicular region. This node also disappeared after X-ray treatment. Rhinoscopy of the nasopharynx gave a negative result, but an X-ray examination revealed a swelling of the soft tissue of the roof.

15 months later the patient developed rt. trigeminal neuralgia, masticator, paralysis, and total oculomotor paralysis, as well as nasal stenosis and hypacusis. *A flat, submucous tumour was now found in the*

roof and the posterior wall of the nasopharynx. No swelling of the glands of the neck. Biopsy unfortunately omitted. *Skiagram* of basis cranii showed no osseous destruction.

A powerful X-ray treatment (7,300 r. for 30 days) of the nasopharyngeal tumour made the patient almost symptom-free; but 4 months later she died on account of massive intracranial tumour invasion. There were distant metastases to the kidneys (autopsy).

*Epicrisis:* A 48-year-old woman presented a reticulum-cell sarcoma in the nasopharynx, which ran a strikingly long, locally "dumb" course. Started with a glandular tumour in the right parotid gland, which was excised, being regarded as a primary tumour. A prompt recurrence disappeared after X-rays. In the course of the next 4 years glandular tumours in 1) left parotid gland, 2) supraclavicular region, and 3) axilla were submitted to X-ray treatment. Local nasopharyngeal signs and symptoms as well as ingrowth into the base of the skull were not observed till 4 years and 4 months after the onset of the symptoms. The primary tumour was found and treated by irradiation, but the treatment was followed by only a short period of incomplete freedom from symptoms. Death occurred on account of massive, intracranial tumour invasion with distant metastases 4 years and 6 months after the onset of the symptoms.

### Discussion.

The above 2 cases of malignant nasopharyngeal tumour are both characteristic of the particularly polymorphous and misleading pathological picture that these tumour forms present. In both these cases the locally "dumb" nasopharyngeal tumour manifested itself in the first instance by gland metastases to the parotid area, which were regarded as a primary parotid tumour and excised. In the former case the mistaken diagnosis was the more natural to make, because microscopy showed a mixed tumour of the salivary gland type. These fairly rare tumours are known to occur by preference in the parotid gland, but they may also be found elsewhere, among others in the nasopharynx, although they are extremely rare in this place.

As regards the latter case the microscopy of the excised parotid tumour (reticulum-cell sarcoma) should perhaps arouse suspicions of a secondary parotid tumour, since such reticulum-cell sarcomas

have never been observed in the parotid gland (AHLBOM, THERKELSEN). The question ought to be ventilated whether this case might be regarded as a systematized expansion of a reticulum-cell sarcoma; but the intracranial invasion and the whole clinical course argue definitely in favour of a primary nasopharyngeal tumour.

In case 1 the diagnosis of nasopharyngeal tumour was made about 2 years after the first occurrence of symptoms, whereas 4 years elapsed in case 2. These intervals between the first symptoms and the final diagnosis are longer than usually where nasopharyngeal tumours are concerned; but this may be explained by the fact that the local symptoms were so inconsiderable. This was particularly striking in case 2 where, in spite of close searching, the primary tumour was not demonstrated till late in the course, because the tumour belonged to the comparatively rare, submucous, creeping type, which is apt to invade the base of the skull. Reticulum-cell sarcomas in the nasopharynx are more than any other tumours characterized by pronounced metastases in spite of diminutive, "dumb" primary tumour, even for several years (GODTFREDSEN). Case 2 presented thereby the same characteristic, simultaneous trigeminal and eye nerve lesions as case 1. These ophthalmo-neurological signs differ considerably from the worst ever seen in connection with parotid tumours of the malignant type. They may, therefore, contribute to bearing out the suspicion of a secondary parotid tumour.

The metastases to the deep cervical glands, which are otherwise so characteristic of malignant nasopharyngeal tumours, were not present in these cases. But case 2 presented a disseminated gland metastasis (supraclavicular, axillary).

It is doubtful whether the unradical excision of tumour metastases in the parotid gland had any influence on the course of the disease. But the prompt and massive recurrence in the operation area gives an indisputable impression of the biological activity of the tumour tissue (possibly accelerated by the operation).

The two cases reported in this paper both ran a lethal course, and only a temporary improvement was obtained by irradiation. Even though various series of X-ray treatment all had a prompt effect on the different metastases in case 2, the response of the primary tumour to X-rays was of short duration only.



## Summary.

After a brief review of the symptomatology and the histopathology of both malignant nasopharyngeal tumours and of parotid tumours two case histories are reported which illustrate an extremely rare and not previously mentioned course run by malignant nasopharyngeal tumours. The first signs and symptoms of these tumours were those of primary parotid tumours, and accordingly they were in the first instance excised as such; but afterwards they proved to be gland metastases from nasopharyngeal tumours.

The importance, in cases of parotid tumours, of considering the possibility of a secondary tumour, in particular gland metastases from a primary nasopharyngeal tumour, is illustrated in this paper. The differential diagnosis ought to be made partly rhinologically and partly — if possible — roentgenologically. It will then be possible to make the diagnosis far earlier and to institute adequate treatment (X-ray treatment) with a chance of improving the patient's condition temporarily or permanently. In the present cases only temporary improvement was obtained. It should, however, be emphasized that, in the cases of malignant nasopharyngeal tumour, permanent freedom from symptoms can be obtained by irradiation, but that the conditions are naturally less favourable, when the base of the skull is invaded to any great extent.

## Zusammenfassung.

Nach einer kurzen Übersicht der Symptomatologie und Histopathologie sowohl der malignen Nasenrachentumoren als auch der Parotistumoren werden zwei Krankengeschichten wiedergegeben, die einen ausserordentlich seltenen und früher nicht erwähnten Verlauf maligner Nasenrachentumoren veranschaulichen. Die ersten Anzeichen und Symptome dieser Tumoren waren diejenigen primärer Parotistumoren, und folglich wurden sie ersterhand als solche exzidiert. Später erwiesen sie sich jedoch als Drüsenmetastasen von Nasenrachentumoren.

Diese Arbeit zeigt, wie wichtig es ist, bei Parotistumoren an die Möglichkeit eines sekundären Tumors, und ganz besonders an Drüsenmetastasen von einem primären Nasenrachentumour aus,

zu denken. Die Differentialdiagnose ist sowohl auf rhinologischem als auch — wenn möglich — auf röntgenologischem Wege zu stellen. Es wird dann möglich sein, die Diagnose viel früher zu stellen und mit Aussicht auf zeitweilige oder dauernde Besserung des Zustandes des Kranken eine sachgemässe Behandlung (Röntgenstrahlentherapie) einzuleiten. Bei den hier vorliegenden Fällen wurde nur vorübergehende Besserung erzielt. Es ist jedoch zu betonen, dass bei malignen Nasenrachentumoren durch Bestrahlung dauernde Symptombefreiung erzielt werden kann, dass die Bedingungen hierfür jedoch naturgemäss ungünstiger sind, wenn die Schädelbasis in einigemmassen grossem Ausmasse angegriffen ist.

### Résumé.

Après avoir brièvement passé en revue la symptomatologie et l'histologie tant des tumeurs malignes du nasopharynx que des néoplasmes de la parotide, l'auteur apporte les observations de deux cas illustrant l'évolution extrêmement rare, et non signalée jusqu'ici, de tumeurs malignes du nasopharynx. Leurs premiers signes et symptômes furent ceux de tumeurs primitives de la parotide, et en conséquence elles furent d'abord excisées comme telles; mais ensuite il fut prouvé qu'elles étaient des métastases ganglionnaires de néoplasmes du nasopharynx.

L'importance, en cas de tumeurs de la parotide, de songer à la possibilité d'une localisation tumorale secondaire, et en particulier à des métastases ganglionnaires ayant leur point de départ dans une néoplasie primitive du nasopharynx, est mise en lumière dans ce travail.

Le diagnostic différentiel devrait se baser en partie sur la rhinologie et en partie — si faire se peut — sur les Rayons Roentgen. Il sera possible, alors, de poser le diagnostic beaucoup plus tôt et d'instituer un traitement adéquat (par les Rayons X) avec des chances d'améliorer l'état du malade temporairement ou définitivement. Dans les cas présentés seule une amélioration temporaire fut obtenue. Il faut cependant souligner que dans les tumeurs malignes du nasopharynx les irradiations sont capables de supprimer de façon permanente les symptômes du mal, mais que, naturellement, les conditions sont moins favorables quand la base du crâne est envahie sur quelque étendue.

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## Treatment of Cancer of the Colon.

By

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The operative treatment of cancer of the colon has carried a high mortality and, in order to reduce that part of the mortality which is due to peritonitis, many surgeons have adopted the Bloch-Mikulicz procedure, or some modification thereof. Other surgeons — in Sweden, RISSLER, KEY, SÖDERLUND and others — however, have regularly resorted to resection with direct anastomosis. In view of the great advances in recent years, such as the introduction of chemotherapeutics, improved methods of anesthesia and more effective shock prophylaxis and therapy, we might expect a considerable improvement in the results. It seems also probable that this improvement should have been particularly noticeable in resection with direct anastomosis. A short account of the literature on the subject published in the nineteen-forties and of the uniformly treated material at Karolinska Sjukhuset may therefore be of some interest.

Among those who recommend the Bloch-Mikulicz procedure, we may mention first and foremost LAHEY and his school. In 1943 CATTELL reported a material of 133 resections for cancer of the colon during the years 1938—1941. He considers that the modified Mikulicz procedure in two stages is the operation of choice for both right-sided and left-sided cancer of the colon. In the 133 cases the mortality was 11.3 per cent.

JONES, BONDI and BRUBAKER (Cleveland) in 1943 published 77 cases of cancer of the colon, operated according to a modified Mikulicz procedure, during the years 1938—42. The operation performed corresponds principally with RANKIN's method (obstruction operation), which they recommend in left-sided cancer

of the colon, but not in right-sided cases, because the contents of the intestine irritate the skin, and on account of loss of electrolytes and fluid from the ileum. They state: "In addition the mortality of one stage ileocelectomy should not be greater than that of the Mikulicz operation." — — — "Most lesions low in the sigmoid do not lend themselves well to this type of operation. Tension of the distal loop of bowel renders the procedure hazardous, and the amount of mesentery resected is frequently inadequate." — — — "There were 5 hospital deaths, a mortality of 6.5 per cent." — — — "In this series the average hospitalization was 28 days." — — — "The average hospitalization for the closure of the colostomy was 8 days." — — — "Sufficient time must elapse between resection and closure to allow the induration of the tissues about the colostomy to subside entirely. Ten weeks is the optimum interval."

PATTERSON and WEBB, at the Roosevelt Hospital in New York, in 1940, reported 70 cases of cancer of the colon, operated according to the Mikulicz procedure. "Seven of the cases were deleted from the statistical survey, with what we consider adequate justification, as being in no sense a true 'test' of the operation." Even after the elimination of these 7 deaths, their mortality for the remainder was no less than 19 per cent. They nevertheless state: "The Mikulicz procedure is still the safest method of removing a portion of the large bowel. In spite of all the disadvantages of the Mikulicz plan, with its multiple operations and long morbidity, we believe that it is the procedure of choice in the average resectable colonic cancer." ARNOLD, San Francisco, has described a method for resection of the carcinomatous rectosigmoid by a combined abdominal-sacral technique, the Mikulicz procedure being used to re-establish the continuity of the bowel through the sacral incision.

Resection with direct anastomosis was recommended, amongst others, by WANGENSTEEN, who in 1943 reported 46 cases of cancer coli from a two-years' period 1941—1943, with a mortality of 2.1 per cent. He states: "The experience of this clinic suggests that primary resection, employing the closed anastomosis, can be made with relative safety for carcinoma anywhere in the colon as well as for recto-sigmoidal carcinoma."

BABCOCK and BACON (Philadelphia) write in 1945: "At present, because of these various objections, we employ the more radical and much more satisfactory single stage resection with aseptic

end to end anastomosis for all carcinomas of the large bowel above the midrectum and have discarded the Mikulicz-Paul operation except to terminate quickly an operation with gross contamination."

CH. MAYO and LOVELACE in 1941 published the Mayo clinic's material of malignant tumours in the cecum and ascending colon from 1907—1938, consisting of 885 cases. "Resection with a view to cure was performed in 67 per cent. of the cases in this series." — — — "Mortality in cases in which resection was performed with a view to cure, that is excluding exploration and palliative operations, was as follows: for one stage resection, 22.2 per cent; for two stage resection, 28.9 per cent, and for more than two stage resection, 34.5 per cent. This would seem to indicate that, when a one stage resection is found possible and surgically advisable, it has the advantage, in respect to average mortality, over other methods." CH. MAYO and C. SCHLICKE in 1942 reported all the cases at the Mayo clinic in which resection of the right portion of the colon with end to end anastomosis of the ileum and colon was carried out for malignant disease. "Ninety-six such operations were performed by eight surgeons prior to Jan. 1, 1942. There were eighteen hospital deaths, a gross mortality rate of 18.8 per cent. In forty-two cases complementary enterostomy was performed, the mortality rate in this group was 28.6 per cent. In the fifty-four cases in which enterostomy was not performed, the mortality rate was 11.1 per cent. We now regard enterostomy not only as unnecessary, but also as an added hazard in conjunction with resection and anastomosis in one stage. If the surgeon has any misgivings, operation in two stages is preferable to the performance of enterostomy."

CAMPBELL (Minneapolis) writes in 1940: "Although the series is small, I wish to report my limited experience with twelve carcinomas of the colon treated by one stage resection and end to end anastomosis without preliminary or simultaneous colostomy or cecostomy. Nine of the eleven cases were in the sigmoid and descending colon, one was in the splenic flexure, one in the transverse and one in the ascending colon. There was one operative death. This man developed pneumonia late in his convalescence." He further states: "For the present I shall persist in my belief that under ideal conditions the single stage resection with aseptic anastomosis is a reasonable and relatively safe procedure."

STONE and MC LANAHAN (Baltimore) write in 1942: "The

group of 191 cases on which the accompanying statistics are based represents operations that we have performed over a twenty year period in six Baltimore hospitals. All the lesions were proximal to the rectum and, if operable, could be removed by the abdominal route." The operability rate was 77.0 per cent. "Among the one hundred and forty-seven resections of all sorts, there were nineteen deaths, or a mortality rate of 12.9 per cent." — — — "The ideal type of operation in view of the foregoing statements, may be formulated as immediate resection, immediate anastomosis and utilization of the aspects of the aseptic technique."

At the German Surgical Congress in 1940 the surgical treatment of cancer coli was discussed. SCHMIEDEN stated in his introductory address: "Ich halte es persönlich mit REICHEL, der am Schluss seiner grossen Arbeit bekennt: 'Dass trotz Empfehlung der einzeitigen Methoden die grössere Sicherheit für das Leben bei den mehrzeitigen Methoden gegeben ist.' — — — Erfahrung, Temperament und Wagemut des Chirurgen werden nie aufhören, eine grosse, wenn nicht gar die entscheidende Bedeutung bei der Wahl des Operationsverfahrens zu behalten." In the course of the discussion FINSTERER quoted his material from 1910—1940, consisting of 328 cases, 267 of which had been subjected to resection = 81.4 %. In all the resections he had a mortality of 20.6 %. The mortality in the different age groups was as follows: under 60 years of age 117 resections with a mortality of 18.8 %, between 60 and 69 years of age 89 resections with a mortality of 24.7 %, between the ages of 70 and 79 years 55 resections with a mortality of 27.2 %, and between the ages of 80 and 86 years two deaths in six resections. Resection according to the Mikulicz procedure had been performed only in 29 cases, with a mortality of 24.1 %. ANSCHÜTZ stated: "Ich glaube, dass der Aufruf, den er (SCHMIEDEN) an Sie gerichtet hat, und der dahin ging, dass Sie lieber einmal zuviel vorlagern als zuviel resezieren, wenn Sie der Technik nicht absolut sicher sind, noch einmal unterstrichen werden muss." VON HABERER, who had employed both the Mikulicz procedure and resection with direct anastomosis in one stage, recommended the latter. He considers that resection with direct anastomosis, combined with cecostomy, can be employed even in a non-empty intestine, nay, actually in acute ileus in cases where the general condition is satisfactory. He had 172 cases of resection with direct anastomosis in one stage

without cecostomy, with a mortality of 25 per cent., and 123 cases with simultaneous cecostomy, with a mortality of 19 per cent.

Finally as regards Sweden, S. JOHNSON (1943) has published the material from the Surgical Clinic at Lund, for the ten-years' period 1929—1938. It consists of 164 cases, 78 of which were radically operated, with a mortality of 23 per cent. 34 were operated according to the Bloch-Mikulicz procedure and 44 were subjected to resection with direct anastomosis. The mortality was approximately the same in both groups.

In addition, T. EKBLOM has surveyed the colonic cancer material of Södersjukhuset, Stockholm. The cases date from Apr. 1, 1940—Jan. 1946, viz. 99 cases, 56 of which were subjected to resection. Of the latter, 17 were treated by ileocecal resection, with 4 fatalities, 10 by resection according to Bloch-Mikulicz, with 1 fatality, and 29 by direct resection, with 3 fatalities. For all the 56 resections, the death rate thus is 14.3 per cent. In order to restrict the consequences of leakage after direct anastomosis, for tumours of the descending colon, sigmoid flexure and pelvic colon in 26 cases a technique was used, by which it was intended to separate the site of resection in the intestine from the rest of the peritoneal cavity by covering it with peritoneum kept in place by sutures, and to drain the demarcated peritoneal cavity thus produced.

No further literature on the subject seems to have been published from the Scandinavian countries in the nineteen-forties. According to oral information, however, the Bloch-Mikulicz procedure is still largely employed in Denmark.

### Cases from Karolinska Sjukhuset.

The material consists of all the cases of colonic cancer treated at the Surgical and Garrison Departments of Karolinska Sjukhuset during the six-years' period February 1940—February 1946 and is composed of 142 patients (74 men and 68 women); five of these patients had multiple cancers in the colon and rectum.

*The average age* for the whole material is 58 years, and for the radically operated 57.6 years.

*Duration of symptoms:* the patients in many cases came to the hospital after suffering from symptoms for a considerable length



of time. The average time from the onset of the symptoms to the patient's admission to the hospital is 7.3 months.

28 cases, *i. e.* one-fifth, were admitted because of *acute ileus*, which necessitated a relieving operation (as a rule, cecostomy). In 14 of them the disease had advanced so far that they could not be subjected to radical operation; the others were subjected to resection at a later stage: this procedure resulted in only one death, the other thirteen were discharged as cured.

7 patients were admitted because of *peritonitis*, four of the cases being of the diffuse, and three of the localized type, all seven of them originating from a perforation due to the tumour. Two of the cases of the diffuse type, who had been merely drained at the first operation, were subjected to resection at a later stage, and were afterwards discharged as cured.

The site of the tumours in the colon is shown by Table 1.

A *palpable resistance* at the site of the tumour was found in 50 cases, *i. e.* in more than one-third (see Table 1).

Table 1.

*Incidence of extirpable and palpable tumours in the different parts of the colon.*

Site	Total tumours		Palpable tumours	
	Number	Extirpable	Number	Extirpable
Cecum .....	20	13	15	9
Colon ascend. ....	13	9	8	5
Flex. hepat. ....	8	6	1	1
Colon transv. ....	24	14	12	5
Flex. lien. ....	8	6	1	1
Colon desc. ....	13	8	2	1
Colon sigmoid. ....	60	40	11	7

## Operative Procedure and Primary Results.

*Resection* was performed on 93 patients, *i. e.* in 65 per cent. of the cases. In 63 cases the tumour was left-sided and in 30 right-sided. The border-line between a right-sided and a left-sided tumour was put at the transition between the right and central third part of the transverse colon.

I. *Operations* performed on *left-sided* tumours.

A) *Atypical* operations: in two cases only colotomy and excision of the tumour were performed; in one case, because of

multiple cancers, the transverse colon was brought out, followed by extirpation of the lienal flexure, the descending colon and the sigmoid flexure, as a first stage, and the rectum was extirpated at the second stage. In another case the sigmoid flexure with a tumour situated there was resected, the descending colon was brought out to form an artificial anus, the upper rectal opening was closed and the rectum was retained. Finally, in one case with three cancerous tumours, resection was performed with direct joining of the ends of the transverse colon, the upper part of the sigmoid flexure was divided and its proximal end was brought out as artificial anus. At a second stage the sigmoid colon and rectum were extirpated.

B) *Resection with direct joining of the bowel ends* was performed in the other 58 cases. 16 of them were subjected to cecostomy at a first stage, 11 because of acute, and 5 because of chronic ileus. In the other 42 cases the operation was made in one stage. In 12 of them a cecostomy was done at the same time, and in 30 resection was made without a cecal fistula. The anastomosis was made in 45 cases end to end and in 13 cases side to side. Merely in one case, where resection had been made without cecostomy, did a complication arise, which can be attributed to this type of operation.

The case was that of a man aged 62 with a tumor in the lower part of the sigmoid colon. On the sixth day after resection he was given an enema on account of meteorism. It entailed severe abdominal pain and symptoms of peritonitis. On laparotomy no signs of leakage, but a small abscess at the place of the anastomosis had broken and discharged its contents into the abdomen. Drainage and cecostomy. The case issued in recovery.

In no case did the cecostomy conduce to a fatal issue. In those cases where cecostomy was done simultaneously with resection, the hospital stay on an average was merely four and a half days longer than where resection had been performed without cecostomy. As regards the hospitalization after the various operations, see Table 2.

In the 14 cases admitted with acute ileus which necessitated cecostomy, and in which resection was afterwards performed, the time between the establishment of a cecal fistula and the resection averaged 38 days.

With one exception, the cecal fistula had healed when the patient was discharged. 16 healed spontaneously, 9 were closed operatively.



ectomy had to be performed. As the tumour was adherent to the pancreas and renal hilus, profuse bleeding ensued during the detachment, especially from one of the larger renal veins. It was necessary to resort to tamponage. The patient fell into *shock* and never recovered; no signs of peritonitis. Death 8 days after the operation. Postmortem refused.

5. *Man aged 71.* Cancer in the middle of the transverse colon. Resection with end to end anastomosis was performed under general anesthesia. Severely affected after the operation, and death 7 days later. The postmortem showed *pneumonia* of the aspiration type.

## II. Operations performed on *right-sided* tumours:

a) In one case with the tumour situated in the hepatic flexure the patient was admitted because of peritonitis. Laparotomy plus drainage. At a later stage resection of the hepatic flexure was made in accordance with the Bloch-Mikulicz procedure. The patient was discharged as cured.

b) In the other 29 cases the operation took the form of *ileo-cecal resection* plus *ileotransversostomy*. The anastomosis in 26 cases was made side to side and in 3 cases end to side. In 25 cases this operation was performed in one stage. Out of the four who had been operated in several stages, two had been admitted because of acute ileus. In the latter cases a cecostomy was first carried out and, at a second stage, ileocecal resection plus ileotransversostomy were performed. Both these cases were afterwards discharged as cured. In one case, on account of a perforation peritonitis from a cecal cancer, ileotransversostomy plus drainage was made in one stage and ileocecal resection at a second stage. The patient was discharged as cured. Finally, in a fourth case, owing to a very poor general condition, the last iliac loop was divided, the distal ileum end was closed and ileotransversostomy was done, as a first stage. Ileocecal resection was carried out at a later stage. In this case likewise the patient was discharged as cured.

Out of the 30 patients subjected to resection because of a right-sided tumour, seven died, *i. e.* a mortality of 23.3 %.

The seven deaths:

1. *Woman aged 75.* Cancer ceci. Ileocecal resection plus ileotransversostomy plus excision of a goose-egg-sized liver cyst plus intra-peritoneal drainage. In the post-operative course meteorism, after a week increasing; death 13 days after the operation, of peritonitis. The postmortem showed *leakage* of the ileotransversostomy and a diffuse, purulent peritonitis.

2. *Woman aged 70.* Cancer in the ascending colon. Ileocecal resection plus ileotransversostomy. 16 days after the operation signs of an intraperitoneal abscess, which was incised. Death 37 days after the operation, of peritonitis. The postmortem showed a tangerine-sized *suture gap* in the ileotransversostomy, plus peritonitis.

3. *Man aged 60.* Cancer ceci. Ileocecal resection plus ileotransversostomy. After a week meteorism. 9 days after the operation, pneumonia with high fever. 17 days after the operation a retroperitoneal abscess in the right flank was incised. 3 days later discharge of fecal matter from the incision wound; progressive change for the worse. Death 70 days after the operation. Postmortem refused. Cause of death: *retroperitoneal abscess, possibly due to leakage.*

4. *Man aged 64.* Cancer in the hepatic flexure. Ileocecal resection plus ileotransversostomy. Two days after the operation increasing meteorism sets in. 7 days after the operation, pulmonary embolism. Death 9 days after the operation. The postmortem showed an *embolus* in a main branch of the pulmonary artery. The small intestine considerably distended, the anastomosis constricted; *ileus* picture.

5. *Man aged 54.* Cancer in the hepatic flexure. Ileocecal resection plus ileotransversostomy. Death 33 days after the operation, of peritonitis. The postmortem showed an *intraperitoneal abscess*; the anastomosis intact.

6. *Woman aged 64.* Cancer ceci. Ileocecal resection plus ileotransversostomy. No liver metastases were noticed. 4 days after the operation icterus, which rapidly increased. Death 10 days after the operation. Postmortem refused. Presumed cause of death: *liver metastases.*

7. *Man aged 72.* Cancer ceci. Ileocecal resection plus ileotransversostomy. Death 6 days after the operation, of *pneumonia.*

As to the operation and the mortality figures, see also Table 3.

The more advanced the cases operated, the higher, of course, the mortality. We were very active and operated several cases where the tumour had spread to adjacent parts. As even such cases may issue in recovery, these extensive operations seem to be justified.

*Cases which were complicated, or required major operations:*

1. The tumour had spread to the adjacent parts, for which reason, in addition to resection of the colon, a wedge-shaped resection of the stomach and splenectomy were also performed. Death 8 days after the operation.

2. The tumour invaded the vicinity, for which reason resection of the colon and small intestine was performed as well as a wedge-shaped resection of the stomach. Death 8 days after the operation.

3. As the tumour had spread to adjacent parts, a resection of the colon and small intestine, resection of the bladder and extirpation of the adnexa and uterus were performed. The cancer invaded the mucosa of the bladder and was at first diagnosed as a vesical tumour. The patient is living free from symptoms after 4 years.

Table 3.  
*Operative procedure.*

	Number	Deaths	Mortality %
<i>Radical operations.</i>			
I. Left-sided tumours			
Resection with direct anastomosis in one stage			
without cecostomy .....	30	2	
with " .....	12	1	
Resection with direct anastomosis after previous			
cecostomy .....	16	2	
Resection of colon sigmoideum + anus iliac.			
sin + closing of upper rectal end .....	1	0	
Resection of colon desc. et sigm. + anus iliac.			
sin. + rectum extirpation .....	1	0	
Resection of colon transv. + division of colon			
sigm. with anus iliac. sin. + rectum extirpa-	1	0	
tion .....	2	0	
Colotomy + excision of tumour .....	2	0	
Total left-sided tumours	63	5	7.9
II. Right-sided tumours			
Ileocecal resection + ileotransversostomy			
in one stage .....	25	7	
in two stages .....	4	0	
Bloch-Mikulicz .....	1	0	
Total right-sided tumours .....	30	7	23.3
Total radical operations	93	12	12.9
<i>Palliative operations</i>			
Anastomosis operations .....	12	4	
Cecostomies .....	11	8	
Anus iliacus sin. ....	4	0	
Small bowel fistula .....	2	1	
Total palliative operations	29	13	
<i>Exploratory laparotomies</i> .....	15	5	
<i>Not operated</i> .....	6		
Total	143		

One patient subjected to radical operation on two occasions for tumours situated at different places in the colon.

4. The tumour had spread to the duodenum. Wedge-shaped excision of the duodenal wall plus ileocecal resection. Discharged as cured.

5 and 6. Two cases where the tumour had invaded the left adnexa, which had to be removed; discharged as cured.

7. As the tumour was situated close to the splenic hilus, bleeding, which entailed splenectomy, ensued there. Discharged as cured.

8. On account of cancer in the transverse colon and in the sigmoid flexure, resection was performed in two places in one stage. Discharged as cured.

9. On account of multiple cancers, transverse resection of the transverse colon and division of the sigmoid flexure, the upper end being brought out as artificial anus. In a second stage extirpation of the sigmoid flexure and rectum. Discharged as cured.

10. On account of multiple cancers, division of the transverse colon, the proximal end being brought out as artificial anus. Resection of the descending colon and sigmoid flexure. As a second stage, extirpation of the rectum. Discharged as cured.

11, 12 and 13. Liver metastases were present, in one case, of the size of a hen's egg; death  $3\frac{1}{2}$  months after the operation. In another case, walnut-sized; the patient is alive one year and five months after the operation. Finally, one case with two small suspected metastases; death one year and 7 months after the operation.

14. On account of gallstones, cholecystectomy simultaneously with ileocecal resection. Discharged as cured.

Table 4 shows the operative mortality among radically operated patients, tabulated according to age. We see how the mortality rapidly rises with age. In 46 cases under the age of sixty, the mortality is only 4.3 per cent. In 47 cases over the age of 60, it is 21.3 per cent.

Table 4.

*Operative mortality in different age groups of radically operated patients.*

Age	Number	Deaths	Mortality %
20—29 .....	2	0	0
30—39 .....	9	0	0
40—49 .....	11	0	0
50—59 .....	24	2	8.3
60—69 .....	31	5	16.1
70—74 .....	12	3	25.0
75—79 .....	4	2	50.0

Among the 46 patients under the age of 60 the mortality is 4.3 %.

Among the 47 patients over the age of 60 the mortality is 21.3 %.

### Pre- and Post-operative Treatment.

For a favourable result of the operation an effective pre- and post-operative treatment is required. It is essential to eliminate a possibly existing anemia and hypoproteinemia, and also to bring the patient into a salt and fluid balance. In cases of colonic cancer dehydration often exists, and even if anemia and hypoproteinemia are present, normal rates of hemoglobin, red cells, hematocrit readings and serum proteins may be counterfeited by hemoconcentration. It is therefore essential to ascertain whether the patient has symptoms of desiccation, such as a small amount of urine, a dry tongue, poor tissue turgor, etc., so that his condition can be properly recognized and a rational therapy introduced.

We have also attached great importance to the colon being

empty before resection and, as above indicated, on isolated occasions when this could not be attained we have performed a cecostomy as a first stage operation. We have had no complications from laxation in cases of obstructive tumours. If the patient had complained of attacks of pain resembling ileus, the laxation was discontinued and the condition alleviated with opium, whereupon a more cautious laxation was tried.

Chemotherapeutical preparations were administered to a very considerable extent, and as a rule orally. The preparation was given some days before the operation and as a rule for a week after it. Out of 93 radically operated patients, 66 had been treated with chemotherapy. 46 of them had received both pre- and postoperative treatment, 3 only preoperative, and 17 only postoperative. As a rule we use easily absorbable preparations, such as sulfathiazole, sulphapyridin, sulphadimine and elkosin, considering that the effect of these preparations on the infection in the intestinal wall and tumour via the blood vessels is of greater importance than the possible effect on the intestinal contents which the scantily absorbable preparations can produce. Out of our five patients with leakage three had not received chemotherapeutical preparations, the fourth had merely received these intravenously for 48 hours after the operation and the fifth, who received satisfactory chemotherapeutic treatment, had been subjected to a very extensive and complicated operation. Moreover, the majority, in connection with the operation, had received sulfathiazole locally at the place of the anastomosis.

Recently, in the more delicate cases we have administered penicillin, especially in view of the danger of pneumonia.

As early as a few days after the operation we began to give prostigmin injections and paraffin oil orally, in order to facilitate spontaneous bowel movement. Enemas during the two weeks following the operation may contribute to the origination of suture leakage, and in one case in our material an enema given at an early stage may possibly have conduced to this complication.

The danger of thrombosis and embolism is, of course, great in these frail patients. During the last 3 years we have as a rule treated them prophylactically with dicoumarin. Thrombo-embolism complications occurred within the entire material merely in four cases.

Improved methods of anesthesia have certainly had an important bearing on our results. We adopted mainly spinal anesthesia,



supplemented with narcotal and gas anesthesia, as a rule nitrous oxide, occasionally cyclopropane.

### Results of Follow-up Examination.

Too short a time has yet elapsed to enable us to judge late results. As we had extirpated the tumours even in very far advanced cases, we must expect that many patients will die of metastases. This anticipation was in fact confirmed at a follow-up examination of the material in October 1945. During the first year after removal of a tumour 8 patients had died of cancer metastases, two of them  $3\frac{1}{2}$  months, one  $5\frac{1}{2}$  months, and the other five in the course of the second half-year, after the resection. One died of an intercurrent disease, cerebral thrombosis,  $3\frac{1}{2}$  months after the resection. Though it is depressing that so many patients should have so soon died of metastases, it must not be forgotten that many of them had had a less painful end.

In a follow-up examination of the fate of the non-resected patients, one is likewise confirmed in the view that intestinal tumours should be removed even in far advanced cases. This examination showed that, out of the 26 cases discharged from the hospital after being subjected to exploratory laparotomy, palliative colostomy or anastomosis operation, no less than 24 had died. The average duration of life for these patients was but  $5\frac{1}{2}$  months after operation. (For details, see Table 5.)

Table 5.

*Follow-up examination in October 1945 of the non-radically operated.*

	Year after op.	Alive	Dead.
Anastomosis cases . . . .	0—1	0	8
	Average duration of life 4.2 months		
Palliative ileo- and colostomy cases . . . . .	0—1	1	6
	1—2	0	1
	Average duration of life 6.9 months		
Exploratory laparotomy cases . . . . .	0—1	1	8
	1—2	0	1
	Average duration of life 5.1 months		

### Discussion and Conclusions.

The colonic cancer material at the Karolinska sjukhuset has been treated on uniform lines, but no less than 13 different surgeons performed the 93 radical operations.

We are of the opinion that the acute cases of ileus should first be subjected to a relieving operation, as a rule in the form of cecostomy. In other cases we consider that primary resection with direct anastomosis should be performed. If the intestine is not empty, if the anastomosis seems to be constricted or if, because of a complicated operation, an intestinal paresis is anticipated, a cecostomy should be carried out simultaneously with resection. As we have not lost any patient owing to cecostomy, and as, in conjunction with the resection, it did not appreciably prolong the hospital stay, we consider that in doubtful cases one should not hesitate to perform a cecostomy.

For the left-sided colonic cancers, in cases of resection with direct anastomosis, we have a mortality of only 8.6 per cent. We believe that the Bloch-Mikulicz procedure could not have prevented a single one of the deaths in this group. Compared with that procedure, direct anastomosis has the advantage, in our opinion, that the operation is more radical, as more of the intestine can be removed and especially a larger part of the mesocolon, together with any lymph-gland metastases possibly present. Moreover, after direct anastomosis the post-operative course is less protracted and more easy to the patient.

In our right-sided colonic cancers we have as a rule adopted ileocecal resection with ileotransversostomy in one stage, with a mortality of 23.3 per cent. To judge by the literature, the Bloch-Mikulicz procedure could not have reduced the mortality in this group either. We intend therefore to continue with the same technique, and hope that a further improvement in the pre- and post-operative treatment may reduce the mortality, which is remarkably high as compared with that in the case of the left-sided tumours.

Our experience has forced us to the conclusion that resection and direct anastomosis is the operation of choice.

In view of the fact that one case out of 28 in this material had multiple cancers in the colon and rectum, one should not merely X-ray the whole colon, but also palpate it thoroughly during the operation.

### Summary.

The author reviews some literature referring to the treatment of colonic cancer published during the nineteen-forties. There still

seems to be a divergence of opinion in regard to the choice between resection with direct anastomosis or some form of the Bloch-Mikulicz procedure.

The author then reports the colonic cancer material in the Surgical and Garrison Departments of Karolinska Sjukhuset for the six-years period 1940—1946. It consists of 142 patients, 93 of whom, *i. e.* 65 %, were subjected to some form of radical operation, with a mortality of 12.9 per cent.

The acute cases of ileus were subjected to a relieving operation, as a rule in the form of cecostomy, as a first stage. In other cases resection with direct anastomosis was performed in one stage, usually without cecostomy.

In the 63 left-sided cases of tumour the mortality was 7.9 per cent. Not a single one of these deaths could have been avoided with the Bloch-Mikulicz procedure. In the 30 cases of right-sided tumour, ileocecal resection with ileotransversostomy was as a rule performed in one stage, with a mortality of 23.3 per cent. The Bloch-Mikulicz procedure could not have improved the results in these cases either.

Our experience has forced us to the conclusion that resection with direct anastomosis is the operation of choice, especially as the Bloch-Mikulicz procedure is less radical and entails a more protracted post-operative course.

### Zusammenfassung.

Verf. berichtet über eine Anzahl Schriften über die Behandlung von Cancer coli, die in den 1940er Jahren erschienen sind. Die Ansichten scheinen nach wie vor auseinanderzugehen, wenn es sich um die Wahl zwischen der Resektion mit direkter Anastomose und irgendeiner Form der Bloch-Mikulicz'schen Vorlegungs-methode handelt.

Verf. berichtet darauf über das Cancer coli-Material aus der Chirurgischen Klinik und der Militärabteilung des Karolinischen Krankenhauses während der 6jährigen Zeitspanne 1940—1946. Es besteht aus 142 Kranken, von denen an 93, d. h. 65 %, irgendeine Form von Radikaloperation vorgenommen wurde, und zwar mit einer Mortalität von 12.9 %.

An den Fällen von akutem Ileus wurde in einer ersten Sitzung eine entlastende Operation vorgenommen, zumeist in Form einer

Zäkostomie. An den übrigen Fällen wurde einzeitig Resektion und direkte Anastomose vorgenommen, zumeist ohne Zäkostomie.

Bei den 63 linksseitigen Tumorfällen betrug die Mortalität 7.9 %. Von den Todesfällen hätte sich sicher nicht ein einziger durch die Bloch-Mikulicz'sche Methode vermeiden lassen. An den 30 rechtsseitigen Tumorfällen wurde in der Regel einzeitig Ileozäkalsektion mit Ileotransversostomie vorgenommen, und zwar mit einer Mortalität von 23.3 %. Auch bei den rechtsseitigen hätte die Bloch-Mikulicz'sche Methode die Ergebnisse wohl nicht verbessern können.

Durch unsere Erfahrungen an dem hier vorliegenden Material sind wir zu der Auffassung gekommen, dass Resektion mit direkter Anastomose die Operation der Wahl darstellt, umsomehr als die Bloch-Mikulicz'sche Methode weniger radikal sein und langwierigeren Nachverlauf geben dürfte.

### Résumé.

L'auteur passe en revue un certain nombre de travaux sur le traitement du cancer du gros intestin, parus depuis 1940. Les avis, à ce qu'il paraît, continuent à être partagés quant au choix entre la résection avec anastomose directe, et la méthode d'extériorisation de Bloch-Mikulicz sous l'une de ses formes.

Ensuite, il apporte le matériel de cancers du colon de la Clinique Chirurgicale de l'Hôpital Carolin et de sa Division Militaire, pendant la période de 6 années, de 1940 à 1946. Il est représenté par 142 malades dont 93, c'est-à-dire 65 %, ont subi une forme, ou une autre d'opération radicale, avec une mortalité de 12.9 %.

Les cas aigus d'iléus ont été soumis, dans un premier temps, à une intervention de décharge, d'ordinaire une coecostomie. Dans les autres, on a fait la résection avec anastomose directe, en un temps, et le plus souvent sans coecostomie.

La mortalité des opérations pour tumeurs du colon gauche a été de 7.9 %. A coup sur, aucune des morts n'aurait pu être évitée par la méthode de Bloch-Mickulicz. En ce qui concerne les 30 cas de tumeurs du colon droit on a dans la règle, pratiqué une résection iléo-coecale avec iléo-transversostomie en un temps, dont la mortalité a été de 23.3 %. Pas plus pour ces lésions du colon droit que pour les autres le procédé de Bloch-Mickulicz n'aurait pu améliorer les résultats.

Notre expérience, basée sur le matériel présenté, nous amène

à conclure que la résection avec anastomose directe est »l'intervention de choix», cela d'autant plus que la méthode de Bloch-Mickulicz est sans doute moins radicale et comporte des suites opératoires plus longues.

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## 200 Fälle von perforierenden Magen- und Duodenalgeschwüren.

Von

OLOF JOHANSSON.

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In den letzten Jahren sind hierzulande über die Behandlung des durchgebrochenen Magengeschwürs mehrere Arbeiten erschienen. Die Hauptfrage war in allen diesen Fällen, ob es berechtigt ist, bei *Ulcus perforans* eine primäre Magenresektion vorzunehmen. Es sind verschiedene Ansichten geltend gemacht worden, die auf Material aus mehreren unserer grösseren Krankenhäuser fussten. Ich habe das Material an *Ulcus perforans* aus der Chirurgischen Klinik des Zentralkrankenhauses in Gefle aus der 15jährigen Zeitspanne 1930—1944 durchgesehen und die Krankengeschichten in bezug auf verschiedene bedeutungsvolle Faktoren studiert. Das Material umfasst 200 Fälle. Von diesen sind 33, oder 16.5 %, gestorben. Da es von grossem Interesse ist, die Veränderung der Sterblichkeitszahlen im Laufe der Jahre zu beobachten, habe ich das Material in Tabelle 1 in Jahrfünften aufgestellt. Aus der Tabelle geht auch die Verteilung auf Männer und Frauen hervor.

Die Mortalität des Gesamtmaterials beträgt 16.5 %. BAGER (1929) hat in seinem Material aus ganz Schweden 1,495 Fälle mit einer Sterblichkeit von 32.8 %, RICHTER (1944) 134 Fälle mit 18 %, BJÖRKROTH (1944) 351 Fälle mit 18.2 % und GELIN (1945) 225 Fälle mit 18.2 %. Ein anschauliches Bild von der sinkenden Tendenz der Mortalität erhält man durch Vergleich der Jahrfünfte im BAGER'schen Material mit denjenigen der Tabelle 1. *Die Sterblichkeitszahlen für die Jahrfünfte betragen in BAGER's Material 41 %, bzw. 35.3 % und 27.1 %. Für die 5-Jahreabschnitte unseres Materials sind die entsprechenden Zahlen 24.2 %, 14.5 % und 11.4 %.*

Die Verteilung auf die Geschlechter zeigt, dass nicht weniger als 176 (88 %) Männer sind und nur 24 (12 %) Frauen. Dies ist

Tabelle 1.

M ä n n e r					F r a u e n			
Jahr	Geheilt	Ge- storb.	Gesamt- zahl	% Ge- storb.	Geheilt	Ge- storb.	Gesamt- zahl	% Ge- storb.
1930.....	5	1	6		2	1	3	
1931.....	8	2	10		2	0	2	
1932.....	5	2	7		1	2	3	
1933.....	11	5	16		1	1	2	
1934.....	12	1	13		0	0	0	
1930—34..	41	11	52	21 %	6	4	10	40 %
1935.....	10	2	12		1	0	1	
1936.....	11	1	12		0	0	0	
1937.....	13	0	13		0	1	1	
1938.....	12	2	14		0	1	1	
1939.....	10	2	12		2	1	3	
1935—39..	56	7	63	11.1 %	3	3	6	50 %
1940.....	7	1	8		0	0	0	
1941.....	7	1	8		2	0	2	
1942.....	14	1	15		1	1	2	
1943.....	12	1	13		2	1	3	
1944.....	16	1	17		0	1	1	
1940—44..	56	5	61	8 %	5	3	8	37.5 %
1930—44..	153	23	176	13 %	14	10	24	41.7 %

ein Überwiegen der Männer, zu dem ich in früher veröffentlichtem Material aus Schweden selten ein Gegenstück gefunden habe. Im Material BAGER's findet man jedoch gleichfalls eine ausgesprochene Neigung zu einer Zunahme des Überwiegens der Männer, wenn man das erste und das letzte Jahrfünft vergleicht, und es ist möglich, dass diese Entwicklungstendenz sich weiterentwickelt hat. Die wahrscheinliche Erklärung der hohen Frequenzzahl für Männer in diesem Material dürfte darin liegen, dass die Kranken hier aus einem Gebiet kommen, in dem die Bevölkerung zu sehr grossem Teil aus Arbeitern besteht, bei denen die Ulkusfrequenz eine hohe ist. Zur Erzielung einer sicheren Auffassung von der wirklichen Häufigkeit von Perforationen bei Männern im Vergleich zu Frauen ist ein grösseres Material aus verschiedenen Teilen des Landes erforderlich.

Bekommen Frauen also verhältnismässig selten Perforationen, so ist hingegen die Prognose bei ihnen bedeutend schlechter als bei Männern. Während die Sterblichkeit für die 176 Männer des Materials aus Gefle in den 15 Jahren 13 % beträgt, ist sie bei den

24 Frauen 41.7 % (siehe Tabelle 1). Stellt man die Zahlen BAGER's aus den verschiedenen Jahrfünften auf Männer und Frauen verteilt auf, wie ich es mit unserem Material in Tabelle 1 gemacht habe, so wird man finden, dass *das eingetretene ausgesprochene Sinken der Mortalität bei Ulcus perforans nur die männlichen Patienten betrifft. Für die Frauen liegen die Sterblichkeitszahlen auf derselben Höhe wie früher.* Für die Jahrfünften im BAGER'schen Material erhält man für Frauen folgende Mortalitätszahlen: 46.3 %, 41.5 % und 42.6 % und für die gesamten 15 Jahre 1911—25 43.3 %. Wie man sieht also Zahlen der gleichen Grössenordnung wie in dem Material aus Gefle. Nun ist freilich der Grössenunterschied der beiden Materiale ein bedeutender und letztere deshalb nicht ganz vergleichbar, doch lässt sich immerhin sicher konstatieren, dass sich die Prognose bei den Frauen nicht in demselben Masse gebessert hat wie bei den Männern. Worauf dies beruht, ist schwer zu sagen, und ich will bei der Besprechung der die Mortalität des Ulcus perforans beeinflussenden Faktoren hierauf zurückkommen.

*Verteilung auf Berufe:* Das Material verteilt sich in der in Tabelle 2 angegebenen Weise auf die verschiedenen Berufe.

Tabelle 2.

Körperarbeiter (Industrie-, Waldarb. u. dgl.) .....	101 (50.5 %)
Geschäftsleute, Handwerker .....	28 (14.0 %)
Landwirte, Hofbesitzer .....	19 (9.5 %)
Wohlfahrtsunterstützte .....	9 (4.5 %)
Intellektuelle Berufe .....	8 (4.0 %)
Übrige Berufe .....	11 (5.5 %)

Gesamtzahl Männer 176

Die Frauen bestehen aus 14 verheirateten und 10 unverheirateten; über ihren Stand liegen nur in einigen wenigen Krankengeschichten nähere Angaben vor, und zwar handelt es sich in diesen Fällen um Dienstmädchen und Haushälterinnen.

Die Ulkuskrankheit stellt ja, wie oft betont wurde, eine Krankheit der körperarbeitenden Bevölkerung dar, und überhaupt trifft sie ganz unvergleichlich viel öfter Personen, die unregelmässige Essgewohnheiten haben oder mitgenommenes Essen verzehren, als Menschen mit regelmässiger Lebensführung. Die Verteilung der Perforationsfälle auf die Berufe kann deshalb nicht wundernehmen, wenn sie auch z. B. in einem Grossstadtmateriale anders aussehen würde als in der obigen Tabelle 2.



*Perforationsfrequenz:*

Durch von mehreren Seiten vorgelegte Zahlen wissen wir, dass das *Ulcus ventriculi sive duodeni* in den ersten Kriegsjahren (bis Ende 1942) in Schweden an Häufigkeit ganz deutlich zunahm. Ferner ist als festgestellt anzusehen, dass die Ulkusfrequenz seit dem Jahre 1943 wieder eine sinkende Tendenz gezeigt hat. Wie hat sich nun die Perforationsfrequenz verhalten? Es ist selbstredend sehr schwer, ja geradezu unmöglich, dies exakt zu berechnen, da keine genaue Zahl für die Anzahl nicht-perforierter Fälle erhältlich ist. Es kommen ja nicht alle Ulkusfälle ins Krankenhaus — eine sehr grosse Zahl von Fällen wird zu Hause gepflegt. Rechnet man mit der Anzahl Fälle, die in der gegebenen Zeitspanne in der hiesigen Chirurgischen Klinik wegen nicht-perforierenden Magengeschwürs operiert wurden, so kann man davon ausgehen, dass nur sichere Ulkusfälle mitgezählt wurden. In den Jahren 1930—44 wurden in der hiesigen Chirurgischen Klinik 1,131 Fälle von *Ulcus ventriculi sive duodeni* operiert, und in der gleichen Zeitspanne waren in der Inneren Abteilung 1,462 Fälle mit dieser Diagnose in Pflege. Die Mehrzahl der hier operierten Ulkusfälle kommt aus der Inneren Abteilung, und es scheint also, dass über  $\frac{3}{4}$  der Fälle zur Operation kommen. Wahrscheinlich handelt es sich um einen noch höheren Prozentsatz, denn viele Kranke haben mehr als einmal in der Inneren Abteilung gelegen, entweder vor der Operation oder nach derselben, besonders war letzteres in einer Zeit der Fall, wo die Ulkusfälle nach der Resektion konsequent zur Nachuntersuchung in die Innere Abteilung übergeführt wurden. Errechnet man nun die relative Perforationsfrequenz für die Gesamtzahl der wegen Ulkus operierten Fälle, so kommt man zu folgenden Zahlen (Tabelle 3):

Tabelle 3.

	Anzahl Perf.	Op. an Nicht-Perforierten	Gesamtzahl	Perf. frequenz
1930—34.....	62	277	339	18.2 %
1935—39.....	69	364	433	16.0 %
1940—44.....	69	490	559	12.4 %
1930—44.....	200	1,131	1,331	15.0 %

Aus Tabelle 3 kann es scheinen, als ob die absolute Anzahl Perforationen im letzten Jahrfünft nicht zugenommen hätte. Dies stimmt nicht mit den von PETRÉN 1942 und 1944 vorgelegten Zahlen über die Anzahl in den Krankenhäusern Schwedens be-

handelter Ulkusperforationen überein. PETRÉN fand eine stetige Zunahme der Anzahl Perforationen, die ihre Höchstzahl 1942 und 1943 erreichten, also ungefähr gleichzeitig damit, dass die Ulkusfrequenz ihr Maximum erreichte. Die Erklärung für die geringe Anzahl Perforationen in den Jahren 1940—44 findet man in Tabelle 1. In den Jahren 1940 und 1941 war nämlich hier eine sehr geringe Anzahl Fälle von *Ulcus perforans* in Pflege, bedeutend weniger als es hätte sein »sollen«. Wenn dies nicht ein reiner Zufall ist, muss es mit den umfassenden militären Einberufungen während des grösseren Teiles dieser Jahre zusammenhängen. Ein grosser Teil der männlichen Bevölkerung stand in Militärdienst, und da, wie ich habe erfahren können, in dieser Zeit in der Gegend von Gefle keine Truppen konzentriert wurden, haben die Ulkuspatienten ihre eventuellen Perforationen andernorts bekommen und sind in anderen Krankenhäusern operiert worden.

Der aus Tabelle 3 ersichtliche Anstieg der absoluten Zahl der Ulkusperforationen vom Jahrfünft 1930—34 zum darauffolgenden Jahrfünft stimmt gut mit der Zunahme überein, die PETRÉN in ungefähr entsprechenden Jahrfünften für die Provinz Gefleborg als ganzes gefunden hat (die Zeitspannen 1931—35 und 1936—40). Die Verschiebung von einem Zeitabschnitt zum anderen beträgt in seinem Material prozentual 13 % und im Material aus Gefle 11 %. Wenn man von den Jahren 1940 und 1941 absieht, so hat von 1930 bis 1944 eine Zunahme der absoluten Anzahl Operationen wegen Ulkusperforation stattgefunden. Die Zunahme ist freilich nicht so stark, wie andernorts, doch hat die Perforationsfrequenz, wie PETRÉN 1942 betonte, in den verschiedenen Teilen des Landes in den verschiedenen Jahren bedeutende Schwankungen aufgewiesen. — Wie verhält sich nun die relative Perforationsfrequenz? Kann man sich Klarheit darüber verschaffen, ob das Ulkus heutzutage häufiger perforiert als früher? Wie erwähnt, ist die absolute Anzahl nicht-perforierender Geschwüre in den letzten Jahren bedeutend gestiegen. Wie aus Tabelle 3 hervorgeht, hat auch die Anzahl Operationen wegen nicht-perforierender Geschwüre bedeutend zugenommen. Dies ist als Ausdruck zweier Faktoren anzusehen: 1. einer Zunahme der Zahl der Ulkusfälle, 2. erweiterter Operationsindikationen beim Ulkus. Eine erhöhte Anzahl Resektionen muss selbstverständlich dazu führen, dass eine gewisse Zahl von Geschwüren sozusagen nie Gelegenheit bekommen, durchzubrechen.

Die relative Perforationsfrequenz wird also in den verschiede-

nen Materialien schwer vergleichbar sein — bei uns ist sie 15 %, BAGER hat 18.1 %. Andere Autoren bringen wechselnde Zahlen, so z. B. MAYO 5 %. Diese Prozentzahlen werden ja davon abhängig sein, wie viele nicht-perforierende Geschwüre operiert werden. An Hand der Zahlen aus dem Kreiskrankenhause Gefle kann man es wagen, zu behaupten, dass sich etwa 10 % sämtlicher Magengeschwüre mit einer Perforation komplizieren. Nun ist dieses Material freilich allzu klein, um diesbezüglich absolut sichere Schlussfolgerungen zu erlauben, doch dürfte dieser Prozentsatz, so weit ich es bei Vergleichen mit anderem Material beurteilen kann, bei unseren heutigen Methoden zur Behandlung der Ulkuskrankheit eine Mindestzahl darstellen.

Tabelle 4.

Graphische Darstellung der Perforationsfrequenz in jedem Monat. Die gerade Linie gibt die von allen meinen Fällen berechnete Durchschnittszahl per Monat an.

30.

25.

20.

15.

10.

5.

Jan.

Febr.

März

April

Mai

Juni

Juli

Aug.

Sept.

Okt.

Nov.

Dez.

— zeigt die Perforationsfrequenz in meinem Material.  
 - - - zeigt die Perforationsfrequenz in Petrén's Material 1911.

*Verteilung auf die Jahreszeiten:* In Tabelle 4 habe ich die Frequenz in den verschiedenen Monaten des Jahres in das Diagramm eingezeichnet. Die Ulkuskranken haben ihre Beschwerden ja zu-

meist periodisch im Herbst und Frühling, und auch die Perforationen zeigen jahreszeitliche Schwankungen. Aus der Kurve geht hervor, dass diese von einer Mindesthöhe im April aus ansteigt und dann in den Sommermonaten in gleicher Höhe bleibt, um im September wieder zu sinken. Dann kommt in den Herbstmonaten wieder ein ausgesprochener Anstieg, worauf der höchste Punkt des ganzen Jahres im Januar erreicht wird, dann ein steiler Abfall auf den Mindestwert im April. Ich habe die von PETRÉN in seiner Dissertation 1911 veröffentlichte Jahreszeitenkurve aus Südschweden eingezeichnet. Wenn man damit rechnet, dass Südschweden in klimatischer Hinsicht der Gefleegend um einen Monat voraus ist, so findet man eine ausserordentlich gute Übereinstimmung der Kurven miteinander. Nun ist dies vielleicht von recht geringem Interesse, doch kann man sicherlich von einer gewissen Periodizität sprechen, auch inbezug auf die Perforationen. In dem grossen Material BAGER's, das ganz Schweden umfasst, findet man die Höchstwerte im Mai—Juni und im Oktober—Dezember. Die Übereinstimmung zwischen meiner Kurve und derjenigen PETRÉN's kann durch Zufall bedingt sein, sie kann aber auch ein Ausdruck dafür sein, dass die Perforationsfrequenz tatsächlich in gewisser Art an die Jahreszeiten gebunden ist. Dass BAGER's Fälle aus ganz Schweden umfassende Kurve gleichfalls einen gewissen Grad von Übereinstimmung zeigt, gibt eine weitere Stütze für diese Annahme ab.

Ich habe bereits oben die bedeutende Besserung der Prognose bei *Ulcus perforans* im Vergleich zu früheren Epochen hervorgehoben. Worauf beruht nun diese Besserung? Dass die Operationsergebnisse heutzutage unvergleichlich viel besser sind als früher, wissen wir alle, und dies ist durch mehrere Faktoren bedingt: bessere Betäubungsmethoden, bessere Thromboseprophylaxe und Thrombotherapie, die moderne Kontrolle der Flüssigkeitsbilanz usw.

Die Prognose bei *Ulcus perforans* hängt in erster Linie von zwei Faktoren ab: vom Alter des Kranken und von der zwischen Perforation und Operation verfloßenen Zeit. In Tabelle 5 habe ich die Fälle nach den Altersgruppen aufgestellt. Ich habe es als genügend erachtet, eine Einteilung in 20-Jahreabschnitte vorzunehmen, obwohl die Gruppe 40—60 Jahre vielleicht in prognostischer Hinsicht etwas heterogen ist.

Zu bemerken ist, dass der jüngste Patient 14 Jahre alt war. Der älteste Patient war 84 Jahre, und der älteste, der genass, 81 Jahre alt.

Tabelle 5.

	1930—34		1935—39		1940—44		1930—44		1930—44	
	gebess.	gestorb.	gebess.	gestorb.	gebess.	gestorb.	gebess.	gestorb.	gebess. in %	gestorb. in %
Alter bis 20...	1	0	1	0	0	0	2	0	100	0
20—40.....	24	2	38	1	30	1	92	4	95.8	4.2
40—60.....	16	4	15	3	28	1	59	8	88	12
über 60.....	7	9	5	6	5	6	17	21	45	55

Die Verteilung auf die verschiedenen Altersgruppen ist ungefähr die gleiche wie im Material BAGER's. Man findet eine ausgesprochene Verschlechterung der Prognose in der Gruppe von über 60 Jahren. Im Alter von 40—60 Jahren ist in den Jahren 1940—44 nur ein einziger Todesfall vorgekommen. Dies kann ein reiner Zufall sein — das Material ist ja so klein — kann aber auch in gewissem Masse dadurch bedingt sein, dass wir jetzt grössere Möglichkeiten haben, auch ältere Leute erfolgreich zu operieren, vor allem durch bessere Betäubungsmethoden und bessere Nachbehandlung. Es ist möglich, dass die Mortalitätszahlen dieser Gruppe sich noch weiter bessern werden. Dagegen kann man in der ältesten Gruppe wohl nicht auf eine bessere Prognose hoffen. Die Zahlen sind in unserem Material inbezug auf diese Kranken ebenso schlecht wie im Material BAGER's von 1911—25. Was die Prognose in dieser Altersgruppe so schlecht gestaltet, ist jedoch nicht das Alter allein, sondern auch der Umstand, dass diese Kranken inbezug auf das Intervall zwischen Perforation und Operation zu einer schlechter gestellten Gruppe gehören, worauf ich später zurückkomme.

Der für die Prognose wichtigste Faktor bei Ulcus perforans wie bei Perforationsperitonitis überhaupt ist das Zeitintervall zwischen Perforation und Operation. Leider enthalten nicht alle Krankengeschichten solche Angaben, dass sich dieses Intervall einigermaßen genau berechnen lässt, doch habe ich an Hand der Aufzeichnungen in den Krankengeschichten bei 162 der 197 operierten Fälle dieses Zeitintervall feststellen können. Unter den 30 Kranken, die operiert wurden und starben, sind in 23 Fällen Angaben über dieses Intervall vorhanden. Zu erwähnen ist auch, dass die prozentuale Verteilung von Gestorbenen und Geheilten unter den 36 Fällen, für die Angaben über das Intervall fehlen, die gleiche ist wie im Gesamtmaterial. In Tabelle 6 habe ich die

Fälle nach verschiedenem Intervall aufgestellt. In der letzten Reihe habe ich die Zahlen BAGER's in Klammern angeführt.

Tabelle 6.

Intervall	Gesund		Gestorben		Gesamtzahl		% gestorb.
	M.	F.	M.	F.	gesund	gestorben	
0—6 St. ....	97	5	8	2	102	10	10.0 % (14.7)
6—12 St. ....	20	4	3	2	24	5	17.2 % (26.5)
12—24 St. ....	9	1	1	2	10	3	23.0 % (47.2)
über 24 St. ....	1	1	4	2	2	6	75.0 % (65.5)

Die Tabelle zeigt, dass 112 Fälle, d. h. 69 %, innerhalb von 6 Stunden eingeliefert und operiert wurden. Die entsprechende Zahl ist für das Jahrfünft 1921—25 in BAGER's Zusammenstellung 45 %. Es lässt sich also ohne weiteres sagen, dass die Kranken jetzt früher, als zuvor, ins Krankenhaus eingeliefert werden. Dieser Umstand ist u. a. mit den bedeutend gebesserten Kommunikationen in Zusammenhang zu setzen. Von den 10 Kranken, die innerhalb von 6 Stunden operiert wurden und starben, waren 6 über 60 Jahre alt, weitere 2 über 50 Jahre, ein Kranker war 48 Jahre und einer 42 Jahre alt. *Von den Patienten, die weniger als 40 Jahre alt waren und innerhalb von 6 Stunden operiert wurden, ist keiner gestorben* (doeh muss man sich hier inbezug auf diejenigen Fälle reservieren, bei denen die Krankengeschichte auf diesem Punkte unvollständig ist).

Die starke Abhängigkeit der Prognose von einer frühen Operation wurde noch kürzlich von BJÖRKROTH (1944) betont, der an dem Material aus dem Krankenhaus Sabbatsberg unter 132 Fällen von unter 40 Jahren, die in den ersten 6 Stunden operiert worden waren, nur 4 Todesfälle hatte. Bei allen diesen 4 Fällen war primäre Resektion vorgenommen worden, und BJÖRKROTH schreibt den unglücklichen Ausgang zum Teil der Operationsmethode zu.

Wie bei der Durchsicht der verschiedenen Altersgruppen, findet man beim Vergleich mit dem Material BAGER's, dass sich die Besserung der Operationsresultate als Ausdruck der Fortschritte der Chirurgie in sämtlichen Intervallgruppen nachweisen lässt, ausser in der letzten. Die mehr als 24 Stunden alten Perforationen haben nach wie vor eine ebenso grundschlechte Prognose, wie sie es immer gehabt haben. Hier ist die Intoxikation durch die Peritonitis schon so weit vorgeschritten, dass sie nur selten wieder rückgängig gemacht werden kann.

Ich habe schon früher erwähnt, dass die Frauen keine Tendenz zu einem Sinken der Mortalität bei Ulkusperforationen zeigen. Lässt sich nun eine Erklärung hierfür in den verschiedenen Zeitintervall- und Altersgruppen finden? Studiert man Tabelle 6, so findet man, dass von den Männern nicht weniger als 89 % innerhalb von 12 Stunden operiert worden waren, während von den Frauen nur etwa 66 % innerhalb dieses Zeitintervalls operiert waren. Noch einmal sei betont, dass die Grösse des Materials für eine sichere Schlussfolgerung zu gering ist, doch ist es immerhin gross genug um den Fingerzeig zu geben, dass die Frauen tatsächlich aus irgend einem Grunde später ins Krankenhaus und zu der lebensrettenden Operation kommen. In veröffentlichten grösseren Materialien findet man in dieser Hinsicht einen mindestens ebenso ausgesprochenen Unterschied.

Inbezug auf das Alter ist zu bemerken, dass von den 10 gestorbenen Frauen des Gesamtmaterials eine 42 Jahre alt ist, eine 59 Jahre und die übrigen über 60 Jahre. D. h. 80 % der gestorbenen Frauen gehören der höchsten und prognostisch am schlechtesten gestellten Altersgruppe an. — *Von den 24 Frauen sind nicht weniger als 46 % über 60 Jahre alt, während von den Männern nur 18.7 % zu dieser Altersgruppe gehören.*

Ich habe bereits oben, bei der Besprechung der Bedeutung des Alters für die Prognose erwähnt, dass die ältesten Kranken später zur Operation kommen, und dass also nicht das Alter allein die hohe Mortalität verschuldet hat. Es stellt sich heraus, dass 45 % der Kranken von über 60 Jahren innerhalb von 6 Stunden eingeliefert werden, während die entsprechende Zahl am Gesamtmaterial (wenn das Zeitintervall angegeben ist) 69 % beträgt. Es scheint also, dass die älteste Altersgruppe unter den Kranken, die innerhalb von 6 Stunden zur Operation kommen, prozentual schwächer vertreten ist. Von 17 Kranken von über 60 Jahren, die innerhalb von 6 Stunden eingeliefert wurden, sind 6, d. h. 35 %, gestorben, während die Sterblichkeit der gesamten Gruppe 0—6 Stunden 10 % beträgt. Zusammenfassend also:

1. Die Prognose innerhalb von 6 Stunden ist sehr gut, wird aber bedeutend schlechter, wenn der Kranke über 60 Jahre alt ist.

2. Die Prognose zwischen 6 und 24 Stunden nach der Perforation ist heutzutage verhältnismässig gut, wenn der Kranke unter 40 Jahre ist.

3. Die Prognose ist bei über 24 Stunden alten Perforationen sehr schlecht, selbst bei jüngeren Personen.

4. Die Prognose ist für Frauen schlechter als für Männer, erstens weil sie in der Regel einer älteren Gruppe angehören, und zweitens weil sie später zur Operation kommen.

*Die Dauer der Ulkussymptome vor der Perforation wechselt.* Die Mehrzahl der unter Perforationssymptomen Erkrankenden haben früher Ulkussymptome aufgewiesen. In 184 Fällen kann man aus der Vorgeschichte folgern, wie lange der Kranke Ulkussymptome gehabt hat, oder jedenfalls dass er welche gehabt hat.

Tabelle 7.

Ohne vorausgehende Symptome .....	26 Fälle
Mit Symptomen höchstens 1 Woche .....	15 »
» » 1 Woche—1 Monat .....	24 »
» » 1 Monat—1 Jahr .....	12 »
» » über 1 Jahr .....	107 »

*Die Anzahl der Fälle ohne vorausgehende Symptome beträgt 13 % des Gesamtmaterials.* Im Schrifttum findet man ähnliche Zahlen (BAGER 11 %). Wie auch frühere Autoren immer betont haben, ist diese Gruppe in Wirklichkeit sicherlich kleiner. Die Kranken sind bei der Krankenhausaufnahme durch ihre Bauchschmerzen beeinflusst und denken nicht an frühere, vielleicht leichte Magenbeschwerden. Würde man nach der Operation immer die anamnestischen Angaben vervollständigen, so würde sicherlich eine bedeutende Anzahl von Fällen aus der Gruppe »Perforation ohne vorausgehende Ulkusanamnese« ausscheiden. Auch Patienten, die vor langer Zeit ein Ulkus gehabt haben und deswegen behandelt worden sind, und deren Rezidiv mit einer Perforation ansetzt, werden wahrscheinlich manchmal zu dieser Gruppe gezählt. — Zu der Gruppe »Symptome mehr als 1 Jahr vor der Perforation« sind diejenigen Fälle gerechnet worden, wo die Krankengeschichte periodische Beschwerden seit mehreren Jahren angab, sowie Fälle mit längerer Zeit bestehenden, fortdauernden Magenbeschwerden. Bei 7 dieser Fälle hatte der Kranke schon früher Ulkusbeschwerden gehabt, war dann lange Zeit gesund gewesen und hatte seine Perforation nach höchstens einige Wochen dauernden Symptomen bekommen. In 1 Fall war der Kranke 7 Jahre früher operiert, wobei eine Gastro-Enterostomie gemacht worden war, war darauf symptomfrei gewesen, hatte aber dann nach einige Jahre bestehenden erneuten Beschwerden eine Perforation bekommen.

Bei 3 Fällen ist angegeben, dass der Kranke »ab und zu unbedeutende Magenbeschwerden« gehabt habe, und bei 6 Fällen,



dass er Symptome gehabt habe aber nicht wie lange. Bei 8 Fällen schliesslich fehlen Angaben dieser Art gänzlich.

*Die Diagnose und ihre Probleme:* Gewöhnlich sind die subjektiven Symptome und das klinische Bild bei einer Ulkusperforation so charakteristisch, dass die Diagnose selten auf Schwierigkeiten stösst. Den äusserst heftigen und blitzartig einsetzenden Perforationsschmerz können die Kranken fast immer beschreiben, selbst wenn ihr angegriffener Kräftezustand es schwer macht, eine volle Anamnese zu erhalten. Die Kranken halten sich mit Vorliebe bei den bei der Untersuchung und gleich vorher vorliegenden Symptomen auf; wenn der untersuchende Arzt sich jedoch immer bemüht, den eigentlichen Krankheitsbeginn klarzulegen, so wird es wohl in der Mehrzahl der Fälle gelingen, eine Angabe über die Initialschmerzen und ihren Charakter zu erhalten. Liegen ausserdem Angaben über frühere Ulkusbeschwerden vor, so erleichtert dies die Diagnose; doch fehlen, wie oben betont, bei über 10 % der Fälle alle vorausgehenden Ulkussymptome.

Was den Untersuchungsbefund anbelangt, so will ich mich nicht bei dem brettharten, typischen Peritonitisbauche aufhalten, der, nach den Krankengeschichten zu urteilen, bei der ganz überwiegenden Mehrzahl der Fälle vorkam. Doch ist der Bauchbefund nicht immer typisch gewesen. In vielen Fällen gab der Kranke bei der Aufnahme maximale Druckempfindlichkeit in der rechten Fossa iliaca an und bei der Palpation per Rectum in der Fossa Douglasi. Dies hängt mit dem Umstand zusammen, dass der Mageninhalt von der Perforationsstelle am Duodenum oder Magen aus den rechten Leberlappen entlang zwischen Leber und Querkolon gegen die rechte Flanke fliesst und darauf die laterale Bauchwand entlang gegen das Becken hinunter. In der Anamnese tritt dies in Form einer »Schmerzwanderung« zutage, die an die bei der Appendizitis typische erinnern kann. Gerade diese »Schmerzwanderung« ist, nach den Krankengeschichten zu urteilen, die häufigste Ursache der Fehldiagnose Appendizitis gewesen. Studiert man die Angaben der Krankengeschichten, so findet man jedoch, dass der Schmerzwanderung bei *Ulcus perforans* fast immer der *heftige Perforationsschmerz vorausgeht*, während bei der Appendizitis die initialen Schmerzen im Epigastrium von diffusorem, allmählich einsetzendem Charakter sind. Bei sehr kleinen Perforationen von Duodenalgeschwüren, wo nur eine geringe Menge Flüssigkeit in die freie Bauchhöhle gelangt, findet man

einen Krankheitsbeginn, bei dem der typische Perforationsschmerz fehlen kann. Ich habe kürzlich solch ein kleines Geschwür am Duodenum beobachtet, wo es nicht einmal nach der Operation möglich war, eine andere anamnestiche Angabe zu erhalten als »allmählich einsetzender, dumpfer Schmerz im Epigastrium, der nach etwa einer Stunde nach unten-rechts hinüberwanderte«. Die Diagnose vor der Operation war in diesem Falle Appendizitis.

Wartet man ab, so ist die Folge oft, dass bei der nächsten Untersuchung die Peritonitissymptome in der unteren Partie des Bauches vorherrschen, was noch leichter zur Fehldiagnose Appendizitis führt. Nun kann es natürlich auch vorkommen, dass die Perforationsöffnung sehr bald in dieser oder jener Weise verstopft wird und keine weitere Flüssigkeit herauslässt — man bekommt eine »gedeckte Perforation«. Dies kann dazu führen, dass die Symptome seitens des Epigastriums abklingen, wobei der Bauch in seiner oberen Partie völlig weich werden kann, während in der rechten Fossa iliaca und der Fossa Douglasi maximaler Druckschmerz vorliegt. *Von grösster Bedeutung und in vielen Fällen für die Diagnose ausschlaggebend ist bei allen Fällen von peritonitischer Reizung in der rechten Fossa iliaca der Charakter der Initialsymptome.*

Heutzutage haben wir in der Röntgenuntersuchung ein ausgezeichnetes Hilfsmittel für unsere Diagnostik der akuten Bauchfälle. Was das Ulcus perforans anbelangt, so geht diese Röntgenuntersuchung darauf aus, freies Gas in der Bauchhöhle nachzuweisen. In sehr grossem Ausmasse wird diese Untersuchung auch bei Fällen vorgenommen, wo die Diagnose klinisch als sicher anzusehen ist. Der Nachteil für den Kranken ist verhältnismässig unbedeutend, und der durch die Untersuchung bedingte Zeitverlust in den meisten Fällen bedeutungslos. Röntgenuntersuchungen sind jedoch, wie wir alle wissen, nicht 100 %ig sicher, wenn es sich um Diagnosestellung handelt, sondern vielmehr ein Hilfsmittel für den Kliniker. Bei Ulcus perforans muss man damit rechnen, dass eine gewisse Zahl von Fällen nicht durch Röntgenuntersuchung nachweisbares freies Gas in der Bauchhöhle aufweist.

Die Angaben über die Anzahl der röntgennegativen Fälle wechseln. Die Zahlen schwanken zwischen 10 und 35 %. FRIMANN-DAHL hat unter 116 Fällen 18 % negative, KLASON unter 81 Fällen 10 % negative. — In meinem Material sind 150 Kranke auf freies Gas hin untersucht worden, und von ihnen sind 34, d. h. 23 %, negativ gewesen. Unter diesen negativen Fällen konnte

man bei *einem*, nachdem man einige Stunden zugewartet hatte, bei erneuter Untersuchung freies Gas nachweisen — die nach der Perforation verflossene Zeitspanne scheint sonst für das Vorkommen von freiem Gas belanglos zu sein. In *einem* weiteren Falle wurde eine Kontrastfüllung des Magens vorgenommen, und diese gab über die Perforation Bescheid. Über die Kontrastfüllung bei Perforationsperitonitis herrschen geteilte Ansichten. Im allgemeinen gilt sie als ungefährlich, zieht aber die Röntgenuntersuchung hinaus, was für die Kranken einen Nachteil bedeutet. Ausserdem gibt sie, selbst beim Vorliegen einer Perforation, nicht immer positiven Ausschlag. Von mancher Seite ist betont worden, dass die Kontrastmasse in freier Bauchhöhle für den Kranken gefährlicher sei als Speisereste und anderer, mehr physiologischer Mageninhalt. Wie es hiermit auch stehen mag, so ist die Untersuchung auf freies Gas die wichtigste. Unter den übrigen Röntgennegativen konnte in 2 Fällen beim Eröffnen des Peritoneums bei der Operation freies Gas nachgewiesen werden — doch ist es möglich, dass gewisse Krankengeschichten diesbezüglich unvollständig sind, so dass die Zahl vielleicht höher sein müsste. Bei einem weiteren röntgenuntersuchten Falle konnte in einer mit Flüssigkeit gefüllten Höhle vor dem Magen freies Gas nachgewiesen werden. Die Diagnose »abgesackte Perforation« wurde hier bei der Operation bestätigt.

Welche Konsequenzen hat nun ein negativer Röntgenbefund gehabt? — In der Mehrzahl (27) der Fälle ist das klinische Bild so klar oder doch so stark auf perforiertes Ulkus verdächtig gewesen, dass auf diese Diagnose hin sofort eine Operation vorgenommen wurde. *In 3 Fällen war das klinische Bild so unklar, dass der negative Röntgenbefund ein in 2 Fällen unglückliches Zuwarten veranlasste.* In 4 Fällen führte der negative Röntgenbefund dazu, dass man sich zunächst für die Diagnose Appendizitis entschloss und mit Wechselschnitt und Appendektomie zu operieren begann was man natürlich immer tun muss, wenn die Diagnose unsicher ist.

Ich habe es auch für interessant gehalten nachzusehen, wie sich diejenigen Fälle entwickelt haben, bei denen keine Röntgenuntersuchung vorgenommen worden war. Der Grund dieses Umstandes war natürlich, dass die Diagnose als so sicher angesehen wurde, dass man es für unnötig hielt, eine — wie man meinte — sichere Diagnose durch Röntgenuntersuchung zu bestätigen. In der Mehrzahl dieser Fälle wurde die Operation auf die Diagnose Ulcus perforans hin vorgenommen. In 11 Fällen war die Diagnose

vor der Operation Appendizitis. Die 4 obenerwähnten Fälle, die inbezug auf freies Gas negativ waren, mit einberechnet, ist also Appendizitis als Fehldiagnose 15mal vorgekommen (7.5 %). BÄGER hat unter 1,495 Fällen diese Fehldiagnose in 14 %. Dabei ist jedoch zu bemerken, dass an seinem Material die Röntgenuntersuchung nur bei wenigen (etwa 60) Fällen vorgenommen wurde. Durch vermehrte Frequenz der Röntgenuntersuchung bei akuten Bauchfällen hat die Fehldiagnose abgenommen, was aus den obigen Zahlen hervorgeht und den Wert dieser vervollständigenden Untersuchung bei akuten Bauchfällen darlegt. *In keinem einzigen Falle hat sich in unserem Material die Unterlassung einer Röntgenuntersuchung ungünstig ausgewirkt. Dagegen haben wir in der Gruppe »Röntgenuntersuchte mit negativem Befund« 2 Fälle von tödlichem Ausgang infolge Zuwartens wegen unklarer Diagnose, was zeigt, wie wichtig es ist, sich auf einen negativen Röntgenbefund nicht völlig zu verlassen.*

Die Fehldiagnose Appendizitis ist für den Kranken nie von Belang gewesen, da immerhin ziemlich schnell eine Operation vorgenommen wurde.

Ausser Appendizitis, ist eine weitere Fehldiagnose vorgekommen, die sich für den Patienten nicht nachteilig auswirkte. Es handelt sich um einen Fall, wo die Perforation des Magens in eine Hernia epigastrica hinein stattgefunden hatte, und wo die Diagnose vor der Operation auf eingeklemmte Hernie lautete.

Die Diagnose akute Pankreatitis ist nur in einem Falle vorgekommen, bei dem die Röntgenuntersuchung negativ ausfiel. Dieser Fall führte zum Tode.

Ausser diesen Fällen, seien weitere 2 besonders erwähnt. Es handelt sich um einen Fall (Aufnahme-Nr. 1868/37), wo eine Resektion zur Ausschaltung vorgenommen worden war. Nach dieser wurde der Kranke 19 Tage nach der Operation in die Innere Abteilung übergeführt. Während er noch in der Inneren Abteilung lag, erkrankte er an akuten Bauchschmerzen, was eine Laparotomie veranlasste. Es erwies sich, dass eine Perforation des belassenen Geschwürs vorlag. Die zurückgelassene Pyloruspartie war fest mit dem Pankreas verwachsen. Die Perforation sass an der Vorderseite. Der Kranke erholte sich. Die Resektion zur Ausschaltung hat, nach gewissen Mitteilungen aus den letzten Jahren zu urteilen, immer mehr Anhänger gewonnen, und kürzlich hat JOHNSSON (1945) das Ergebnis einer grösseren Anzahl solcher Resektionen vorgelegt, ein Material, in dem damals kein Fall von

Perforation des belassenen Geschwürs vorgekommen war. Wenn diese Komplikation hiernach auch selten zu sein scheint, muss man in Wirklichkeit mit der Möglichkeit einer Perforation eines belassenen Geschwürs rechnen.

Der zweite Fall war ein Kranker, der 7 Jahre früher wegen Ulkus mit Gastro-Enterostomie operiert worden war, einige Jahre gebessert war, nach etwa zwei Jahre dauernden, erneuten Beschwerden aber eine Perforation bekam.

Gleichzeitige *Blutung und Perforation* ist selten. Der Satz »a bleeding ulcer will not perforate and a perforating ulcer will not bleed« besteht jedoch nicht zu Recht. BARON (1942) hat unter 400 Perforationen 3 % mit gleichzeitiger Blutung. In diesem Material hat ein Kranker seine Perforation im Anschluss an eine akute Blutung bekommen, derwegen er in der Inneren Abteilung lag. Die Kombination akute Ulkusblutung-Perforation scheint also selten zu sein. Hieran ist zu denken, wenn man akute Bauchsymptome bei Kranken mit bestehender Ulkusblutung vor sich hat. Hin und wieder einmal können diese Symptome überaus heftig sein mit Schmerzen im Epigastrium, wo die Kranken auch sehr druckempfindlich sind, in der Regel ist aber der Bauch hierbei weich. Die Symptome erklären sich wahrscheinlich so, dass der stark blutige Mageninhalt auf den Dünndarm einen überaus kräftigen Reiz ausübt, vielleicht eine »mechanische« Enteritis.

*Lokalisation der perforierenden Geschwüre:* Bei 196 Fällen liegen Angaben über den Sitz des Geschwürs vor. Bei vielen dieser Fälle ist nur »Pylorus« verzeichnet, ohne Angabe darüber, ob die Magen- oder die Duodenalseite betroffen war, was bei der Operation ja oft auch schwer zu entscheiden ist. Diese Fälle sind in einer besonderen Gruppe zusammengeführt worden.

Tabelle 8.

Lokalisation	Anzahl Fälle	Mortalität
Magen .....	85	19.0 % (16 gestorben)
Pylorus .....	40	12.5 % (5 " )
Duodenum .....	71	12.6 % (9 " )

Von den Magengeschwüren haben 3 nach hinten in die Bursa omentalis perforiert (0 Todesfälle). Bei 7 der Fälle sass das Geschwür sehr hoch oben an der Curvatura minor, gleich unterhalb der Kardia.

1 Duodenalgeschwür hat nach hintern perforiert. Im Vergleich zu anderen Angaben scheinen bei uns die Perforationen nach hin-

ten in geringer Zahl vorzukommen (reichlich 2 %). BAGER hat 4 % und PETRÉN 11.7 %. Die Perforationen nach hinten haben zu meist eine höhere Mortalität (BAGER), was mit den diagnostischen und operationstechnischen Schwierigkeiten zusammenhängt, doch ist von unseren Fällen kein einziger gestorben, was wohl ein rei ner Zufall sein wird, da es sich um nur 4 Fälle handelt.

Ein sicherer Unterschied der Magen- und der Duodenalge schwüre in bezug auf die Mortalität ist im Schrifttum nicht zu fin den, doch schwanken die Angaben. Wenn man von den Pylorus perforationen absieht, so scheinen die Magengeschwüre jedoch eine etwas höhere Sterblichkeit aufzuweisen als die Duodenal geschwüre.

*Operationsmethode:* Von den 200 Fällen wurden 197 operiert.

Tabelle 9.

Operationsmethode	Anzahl Fälle	Gestorben	Mortalität
Raphie + evtl. Witzelfistel .....	140	14	10 %
Raphie + G. E. ....	4	2	
Exzision + evtl. Witzelfistel .....	38	5	13 %
Primäre Magenresektion .....	3	0	0 %
Laparotomie + Drainage der Bauchhöhle...	6	4	
Laparotomie + Witzelfistel durch die Per foration .....	6	6	
Nicht operiert .....	3	1	

Raphie der Perforation allein ist also die gewöhnlichste Opera tionsmethode gewesen, doch wurde in einigen Fällen, wie aus der Tabelle hervorgeht, eine Exzision vorgenommen. Eine Witzelfistel zu entlastenden Zwecken ist bei 122 der Fälle angelegt wor den. Primäre Schliessung der Bauchhöhle fand in sämtlichen Fäl len statt, ausser in 3, wo eine Drainage als notwendig crachtet wurde (irgendwie nachteilig hat die Drainage in diesen Fällen nicht gewirkt).

Unter den 56 Fällen, wo eine Witzelfistel nicht als notwendig angesehen wurde, sass die Perforation bei 34 (3 gestorben) am Pylorus oder im Duodenum. In diesen Fällen fand auch keine primäre Einlegung einer Duodenalsonde statt, um den Magen die ersten Tage zu entlasten. Den Operationsberichten nach zu ur teilen, dürfte der entscheidende Faktor in bezug auf das Anlegen einer Fistel die Furcht des Operateurs vor postoperativen Pas sageschwierigkeiten durch den Pylorus gewesen sein. Bei den Magengeschwüren wurde deshalb in der Regel keine Fistel ange legt. Für die Entleerungsverhältnisse nach der Operation ausschlag-

*gebend ist jedoch nicht nur die Pyloruspassage, sondern auch in vielleicht noch höherem Grade die Tonusverhältnisse im Magen, und man hat deshalb in vielen Fällen in den ersten Tagen postoperatives Erbrechen gesehen, auch bei hoch oben im Magen sitzenden Geschwüren, wo eine Fistel nicht als notwendig crachtet wurde.*

Ein Nachteil des Fehlens einer Fistel kann ausserdem in einer unnötigen Beanspruchung der Suturen bestehen — in unserem Material haben wir jedoch keinen Fall von Versagen der Nähte. Abgesehen von Erbrechen in den ersten Tagen, sind bei den Fällen ohne Fistel jedoch keine bedeutenderen Nachteile vorgekommen. Doeh dürfte es sicher sein, dass der Kranke es mit einer entlastenden Fistel bedeutend ruhiger hat. Eine die ersten Tage permanent im Magen liegende Duodenalsonde leistet dieselben Dienste wie eine Witzelfistel. Vielen Kranken ist jedoch das ständige Liegen mit einer Duodenalsonde unangenehm. Andererseits ist der Nachteil einer richtig angelegten Witzelfistel gering — höchstens bekommt man durch Infektion vom Fistelkanal aus verspätete Wundheilung. Nach den Operationsberichten zu urteilen, scheint nach Anlegung der Fistel in der Regel keine Befestigung des Magens an das Peritoneum parietale vorgenommen worden zu sein. Dies kann vielleicht eine gewisse Gefahr mitsiehbringen, und in einem Falle ist denn auch eine ernste Komplikation zur Witzelfistel eingetreten. Es handelte sich um einen Kranken, der 28 Tage nach der Operation an subphrenischem Abszess starb, welcher letzteres sich bei der Sektion als mit der noch immer offen stehenden Witzelfistel direkt zusammenhängend erwies. Es ist möglich, dass diese Komplikation nicht aufgetreten wäre, wenn der Magen an das Peritoneum parietale befestigt worden wäre.

Gastro-Enterostomie als primäre Entlastung ist nur in einigen wenigen Fällen angelegt worden. Aus den Jahresberichten unserer Kreiskrankenhäuser geht auch hervor, dass diese Methode heutzutage sehr wenig Verwendung zu finden scheint. — In einem Falle (Aufnahme-Nr. 739/33) bekam der Kranke nach der wegen Perforation vorgenommenen Operation Stenosebeschwerden und lag immerzu mit starker Retention. Fünf Wochen nach der ersten Operation wurde eine Relaparotomie vorgenommen und eine Gastro-Enterostomie angelegt. Darauf glatter Nachverlauf.

Primäre Resektion wurde nur bei 3 Fällen vorgenommen, alle mit günstigem Ausgang. — Die schlechtesten Ergebnisse zeigen diejenigen Fälle, wo man nur die Bauchhöhle drainiert oder durch die Perforationsöffnung eine Fistel angelegt hatte. Dies kann an

sich ja nicht wundernehmen, da die Methoden nur bei den in prognostischer Hinsicht am schlechtesten gestellten Fällen zur Verwendung gekommen sind. Die Kranken waren fast ausnahmslos alt und hatten 24 Stunden alte oder noch ältere Perforationen, zumeist von Magengeschwüren. Ich finde es jedoch fraglich, ob es richtig sein kann, grosse, källöse, perforierende Magengeschwüre sich selbst zu überlassen und den Magen nur durch eine Fistel in der Operationsöffnung zu entlasten, statt das Geschwür zu schliessen, evtl. zu exzidieren, mit Oment zu decken und eine gewöhnliche Witzelfistel anzulegen.

Bei 2 Fällen, wo die Bauchhöhle nur drainiert worden war, hatte keine diffuse Peritonitis vorgelegen: die Perforation hatte bei dem einen Falle einen Abszess zwischen Leber und Magen gegeben. Bei dem anderen lag ein subphrenischer Abszess vor. Dieser letztere Fall gehört wahrscheinlich zu denjenigen, wo die Perforation spontan geheilt war und dann einen Restabszess gegeben hatte. Bei einem der zu dieser Gruppe gehörenden Fälle, der gestorben war, konnte die Perforation denn auch nicht wiedergefunden werden; dagegen lag ein grosser Abszess im Omentum minus vor.

Dass Perforationen spontan ausheilen können, ist u. a. von BAGER betont worden, der in seiner Inaugural-Dissertation auch andere Autoren erwähnt, die spontan ausgeheilte Fälle beschrieben haben. In dem Material aus Gefle haben wir 2 der nicht-operierten Fälle, die dies gleichfalls veranschaulichen. BAGER fragte sich, ob nicht die Diagnose spontan ausgeheilte Ulkusperforation durch ausgedehntere Verwendung der Röntgenuntersuchung mit Nachweis von freiem Gas an Häufigkeit zunehmen würde. Dass sie trotz allem nach wie vor als selten gilt, hängt natürlich damit zusammen, dass unverzüglich operiert wird, so bald Anamnese, Status und Röntgenbefund freien Gases für eine Ulkusperforation sprechen.

Der erste unserer Fälle war ein 33jähriger Mann mit typischem Krankheitsbeginn (doch fehlte eine Ulkusanamnese) und freiem Gas im Röntgenbilde. Doch gingen die Symptome gleich nach der Aufnahme zurück, und da die Röntgenaufnahme von dem betreffenden Chirurgen zuerst falsch gedeutet wurde, wurde der Kranke nach Hause geschickt. Bei der Durchsicht der Röntgenbilder am folgenden Tage wurde der Irrtum entdeckt und nach dem Kranken gesandt. Dieser war jedoch symptomfrei, ohne objektive Anzeichen einer Peritonitis. Später wurde eine Kontrastströntgenaufnahme gemacht und ein Ulcus duodeni nachgewiesen. Nach 1 Monat langer Ulkuskur geheilt entlassen.

Der zweite Fall war ein 62jähriger Mann mit 1½jähriger Ulkusanam-



nese und typischem Krankheitsbeginn. Bei der Untersuchung Andeutung von Muskelspannung im Epigastrium und daselbst Druckschmerz. Röntgen zeigte freies Gas. Aus irgendeinem Grunde, der aus der Krankengeschichte nicht ersichtlich ist, wurde zugewartet, und die Symptome gingen zurück. Die Kontraströntgenaufnahme ergab hier ein hoch oben an der Curvatnra minor sitzendes Ulcus ventriculi.

Der dritte nicht operierte Fall war eine ältere Frau, bei der die Diagnose Ulcus perforans gestellt worden war, die Operation jedoch nicht vorgenommen wurde, da die Kranke gleichzeitig eine Nephritis hatte. Der Fall endete tödlich.

*Komplikationen und Todesursachen:* Die postoperativen Komplikationen bei Ulcus perforans beruhen auf der Peritonitis und ihren Spätkomplikationen. Angaben hierüber liegen in so gut wie allen Krankengeschichten vor. Dagegen fehlen hier Angaben über leichte Wundinfektionen und wahrscheinlich über die leicht verlaufenden Thrombosen. Viele Fälle mit subfebrilen Temperaturen im Nachverlauf haben wahrscheinlich Thrombosen oder auch nicht mittels Röntgen bestätigte Pleurareizungen gehabt. Die Komplikationen findet man in Tabelle 10.

Tabelle 10.

Peritonitis . . . . .	23 (23 gestorb.)	Pneumonie, Broncho-	
Subphren. Abszess . . .	8 (4 » )	pneum. . . . .	10 (2 gestorb.)
Douglasabszess . . . .	4	Thrombose, Embolie .	2 (2 » )
Ruptur d. Laparotomiewunde . . . . .	3 (1 gestorb.)	Kolonfistel . . . . .	1
Pleuritis (ohne Anzeichen eines subphren. Abszesses) . .	5	Dekubitus . . . . .	1 (1 gestorb.)
		Bauchwandabszesse . .	2

Die den Chirurgen am meisten interessierenden Komplikationen sind die 3 ersten, und in diesen Gruppen kann man, wie oben erwähnt, damit rechnen, dass die Angaben der Krankengeschichten vollständig sind.

Von den 23 an ihrer Peritonitis gestorbenen Fällen, starben 5 schon in den ersten 24 Stunden, weitere 11 innerhalb von 4 Tagen und die übrigen 7 innerhalb von 12 Tagen.

12 Kranke haben intraabdominale Restabszesse bekommen, und von ihnen haben 2 als Komplikation eines subphrenischen Abszesses ein Pleuraempyem entwickelt (diese beiden sind gestorben).

*Unter den 177 Fällen, wo der Kranke die Peritonitis überwunden hat, sind in etwa 6 % Restabszesse zur Entwicklung gekommen. Die Zeitdauer zwischen Perforation und Operation scheint bei diesen 11 Fällen keine Rolle gespielt zu haben, 8 der Kranken sind in-*

nerhalb von 6 Stunden und weitere 2 innerhalb von 12 Stunden nach der Perforation operiert worden. — Auch der Sitz des Geschwürs scheint die Entstehung dieser Komplikationen nicht zu beeinflussen, falls das Material nun diesbezügliche Schlussfolgerungen erlaubt.

1 Kranker wurde nach 9 Tagen symptomfrei entlassen, kam aber 10 Tage später mit einem Fieberzustand zurück. Allmählich erwies sich das Leiden als ein subphrenischer Abszess. 3 Monate nach der Operation gestorben.

*Nachuntersuchung:* Von den 167 Kranken, die ihre Ulkusperforation überlebten, sind später, nach eingeholten Angaben, 10 gestorben, darunter 2 an ihrer Ulkuskrankheit. Von diesen zweien starb der eine nach einer Resektion. Es bleiben 157 Fälle, von denen wir über 121 Fälle Angaben erhalten konnten. Die Auskünfte über die Patienten erhielt man zum Teil durch Aussenden von Fragebogen, zum Teil durch Angaben in Krankengeschichten über später im Krankenhaus behandelte Patienten. Das Ergebnis der Nachuntersuchung geht aus Tabelle 11 hervor.

Tabelle 11.

Operationsmethode	Gesamtzahl Nachunter- suchter	Ge- sund	Gebes- sert	Nicht gebessert Rezidiv
Raphie .....	88	23	10	55
Exzision .....	28	7	8	13
Sutur + G. E. ....	1	1		
Resektion .....	2	1	1	
Drainage .....	1	1		
Nicht operiert .....	1			1
	121	33	19	69
		52		

Die Beobachtungsdauer bei den zu der Gruppe Gesunder oder Gebesserter Gezählten beträgt mindestens  $1\frac{1}{4}$  und höchstens 16 Jahre. Ich muss vielleicht darauf aufmerksam machen, dass zur Gruppe der Gebesserten Fälle gerechnet wurden, die angaben, unbedeutende Beschwerden ohne daraus folgender Herabsetzung der Arbeitsfähigkeit zu haben. Die Grenze zu ziehen, ist natürlich schwer, aber so lange der Patient nicht meint, einen Arzt konsultieren zu müssen oder eine Herabsetzung der Arbeitsfähigkeit zu haben, bin ich der Ansicht, dass man die Beschwerden als unbedeutend bezeichnen kann, und diese Fälle mit denjenigen, die sich für gesund ansehen, zusammenwerfen kann.

Wie aus Tabelle 11 hervorgeht, haben 69 Fälle (57 %) von den Nachuntersuchten noch immer bedeutende Beschwerden oder sind wegen ihrer Ulkuskrankheit nochmals operiert worden. Von diesen 69 Rezidivfällen sind 47 Fälle (66 %) erneut operiert worden — in 1 Falle wegen erneuter Perforation; in 44 Fällen<sup>1</sup> wurde Resektion vorgenommen und in 2 Fällen Anlegung einer Gastro-Enterostomie (die beiden letztgenannten Fälle waren ältere Leute, mit vorwiegend Stenosesymptomen). Von diesen erneut operierten Fällen ist 1 im Anschluss an eine Resektion gestorben, was eine Mortalität von 2.2 % bei diesen sekundär vorgenommenen Ulkusoperationen ausmacht. Diese Mortalitätszahl ist zwar auf eine ziemlich geringe Zahl von Fällen berechnet, doch ist sie ungefähr ebenso gross, wie die, mit der man bei Resektion bei früher nicht perforierenden Geschwüren rechnen muss (in den Jahren 1940—45 sind hier in unserer Abteilung wegen Ulkus 551 Magenresektionen vorgenommen worden mit 16 Todesfällen, also 2.9 %). *Wir sind der Ansicht, dass Schliessung, evtl. Exzision, des Geschwürs bei Perforation und sekundär vorgenommene Resektion bei den Rezidivfällen eine geringere Mortalität geben als primär ausgeführte Resektion. Jedoch fehlt uns ein eigenes grösseres Material primärer Resektionen bei Ulcus perforans als Vergleichsmaterial.*

Wie oben betont, sind nicht weniger als 66 % der Rezidivfälle nochmals operiert worden. Dies ist eine bedeutend höhere Zahl als die von BJÖRKROTH (55 %) und GELIN (26 %) gebrachten und hängt mit der im hiesigen Kreiskrankenhaus herrschenden aktiven Einstellung zu Ulkusrezidiven zusammen.

Wenn man die Fälle näher inbezug darauf analysiert, wie bald nach der Perforation ein Resektion veranlassende Rezidiv aufgetreten ist, so findet man, dass 61 % ihr Rezidiv innerhalb eines Jahres bekommen haben und 84 % innerhalb von 3 Jahren. Unter den übrigen war das längste freie Intervall 10 Jahre. — Unter den 22 Fällen, wo der Rückfall noch keinen operativen Eingriff veranlasst hat, ist das Rezidiv in 13 Fällen (59 %) innerhalb von 3 Jahren aufgetreten. Das längste freie Intervall betrug auch hier 10 Jahre.

Die Rezidivfrequenz unter denjenigen Fällen, wo nur eine Vernähung des Geschwürs vorgenommen wurde, ist 62 %, und wenn

<sup>1</sup> An weiteren 2 Fällen ist seit dem Ausschreiben des Manuskripts wegen eines Rezidivs die Resektion vorgenommen worden, so dass die Gesamtzahl jetzt 46 Fälle mit 1 Todesfall beträgt. Diese 2 Fälle bringen auch gewisse andere Veränderungen in den Tabellen mit sich, die die Schlussfolgerungen jedoch nicht beeinflussen.

Exzision des Geschwürs gemacht wurde, 46 %. Dies spricht dafür, dass eine Exzision anzustreben ist, was auch BAGER bereits betont hat. Wenn diese Exzision effektiv sein soll, muss sie jedoch richtig gemacht sein und nicht nur eine Exzision der Perforationsöffnung darstellen.

Der Krankenhausaufenthalt dauerte bei den unkomplizierten Fällen in den früheren im Material vertretenen Jahren 3—4 Wochen. Im letzten Jahrfünft ist die Pflegedauer bedeutend gesunken, und die unkomplizierten Fälle haben selten mehr als 10—12 Tage im Krankenhaus gelegen. Eine Nachbehandlung der Kranken in Form einer sachgemässen Ulkusbehandlung ist nicht vorgekommen. Die Kranken sind mit Diätvorschriften nach Hause entlassen worden.

Es dürfte als ein Mangel unserer Ulkusbehandlung anzusehen sein, dass man den Perforationsfällen nach der chirurgischen Behandlung nicht eine regelrechte konservative Behandlung in einer inneren Abteilung angedeihen lässt. Wenn sich dies durchführen liesse, bin ich überzeugt, dass die Anzahl der Rückfälle — jedenfalls die der frühen Rückfälle innerhalb eines Jahres — bedeutend heruntergedrückt werden könnte.

Die 52 Fälle, die angeben, nach der Operation wegen Perforation gesund zu sein, sind in bezug auf die Dauer der Ulkusbeschwerden vor der Perforation durchgesehen worden. Es stellt sich heraus, dass 4 die Perforation als erstes Symptom bekommen hatten, 9 weniger als 1 Jahr Symptome gehabt hatten und die übrigen 39 länger, bis 15—20 Jahre. Bei denjenigen Fällen, die nach mehr als 10jährigen, periodischen Ulkusbeschwerden eine Perforation bekamen und nach palliativer Operation noch immer symptomfrei sind (im ganzen 5 Fälle), wurde bei zweien eine Exzision des Geschwürs vorgenommen und bei den übrigen 3 nur Vernähung. Bei den 3 letztgenannten Fällen beträgt die Beobachtungszeit 7 bzw. 11 und 12 Jahre, bei den erstgenannten nur 1½ Jahre. Wenn auch eine Exzision anzustreben ist, so zeigt dies doch, dass *bloße Vernähung des Geschwürs langdauernde Rezidivfreiheit geben kann, selbst wenn vor der Perforation eine lange Ulkusanamnese vorgelegen hat.*

Wie lang ist die Beobachtungszeit zu bemessen, damit man ein Ulkus als geheilt ansehen kann? Es stellt sich heraus, dass der Kranke in gewissen Fällen bis zu 10—12 Jahre lang rezidivfrei bleiben kann, um darauf erneut Beschwerden zu bekommen. Soll man dies nun als Rückfall oder als Neuerkrankung buchen? In

unserem Material haben wir 2 Fälle, die nach Operation wegen perforierenden Duodenalgeschwüren 8 bzw. 10 Jahre lang symptomfrei waren, kürzlich von neuem erkrankt sind und beide hoch oben an der Curvatura minor sitzende Magengeschwüre aufweisen.

Die Nachuntersuchung des Materials hat also dargelegt, dass man bei 43 % der Fälle mit palliativen Eingriffen völlige oder fast völlige Symptommfreiheit erlangt hat. Einen Vergleich zwischen Resektion und palliativen Eingriffen lässt das Material nicht zu, da die Resektion nur an 3 Fällen vorgenommen wurde. Ferner erweist es sich, dass 47 Fälle erneut operiert wurden, darunter einer wegen erneuter Perforation. Die Mortalität bei einer späteren Resektion (46 Fälle) betrug 2.2 %, also nicht mehr als die, mit der wir bei operativem Eingriff an früher nicht perforierenden Geschwüren rechnen müssen.

### Zusammenfassung.

Verf. berichtet über 200 Fälle von *Ulcus perforans* aus den Jahren 1930—44. Von diesen sind 33 oder 16.5 % gestorben. — Die Mortalität hat für Männer ein ständiges Sinken gezeigt. In den Jahrfünften 1930—34, 1935—39 und 1940—44 war sie 21, bzw. 11.1 und 8 %. Für Frauen hingegen ist sie ungefähr unverändert geblieben, etwa 40—50 %. Verf. bespricht hiermit zusammenhängende Probleme. — Verf. betont das bedeutende Überwiegen der Männer (88 %) über die Frauen (12 %).

Verf. zeigt, dass, gleichzeitig mit einer Zunahme der Gesamtzahl der Ulkusperforationen in den obenerwähnten Jahrfünften, eine deutliche Abnahme der Perforationsfrequenz eingetreten ist, in Prozent der Gesamtzahl operierter Ulkusfälle (Perforationen + nicht-perforierende Geschwüre, bei denen Resektion oder evtl. Gastro-Enterostomie vorgenommen wurden) gerechnet.

Es werden die für die Prognose wichtigsten Faktoren besprochen, nämlich das Alter der Kranken und das Zeitintervall zwischen Perforation und Operation, und Verf. kommt hier zu folgender Zusammenfassung:

1. Die Prognose innerhalb von 6 Stunden nach der Perforation ist heutzutage verhältnismässig gut, wird aber bedeutend schlechter, wenn der Kranke über 60 Jahre alt ist.
2. Die Prognose zwischen 6 und 24 Stunden nach der Perfora-

tion ist heute verhältnismässig gut, wenn der Kranke unter 40 Jahre alt ist.

3. Die Prognose ist bei über 24 Stunden alten Perforationen sehr schlecht, selbst bei jüngeren Personen.

4. Die Prognose ist für Frauen bedeutend schlechter als für Männer.

Verf. berichtet ferner über die Krankheitsdauer vor der Perforation und weist nach, dass 13 % der Fälle ohne voraufgehende Ulkussymptome perforierten. Gewisse Gesichtspunkte in bezug auf die Diagnostik werden betont. 150 Kranke sind mittels Röntgenaufnahme auf freies Gas in der Bauchhöhle untersucht worden. Von ihnen waren 34, oder 23 %, negativ.

Die verwendeten Operationsmethoden waren hauptsächlich Raphie (140 Fälle) oder Exzision (38 Fälle), evtl. mit Witzelfistel (122 Fälle). Nur in 3 Fällen wurde primäre Resektion vorgenommen. In seiner Nachuntersuchung findet Verf., dass die Rezidivfrequenz bei denjenigen Fällen, wo nur eine Schliessung des Geschwürs stattgefunden hatte, grösser war (62 %) als bei Exzision des Geschwürs (46 %). Eine Exzision des Geschwürs scheint also den Vorzug zu verdienen. 167 Fälle haben die Perforation überlebt. Von ihnen sind 10 später gestorben. Von den übrigen 157 Fällen sind 121 nachuntersucht worden. Von diesen waren 43 % gesund oder doch voll arbeitsfähig. 57 % hatten bedeutende Ulkusbeschwerden. In letzterer Gruppe wurde an 46 Fällen Resektion vorgenommen mit 1 Todesfall (2.2 %). — Die Prognose erscheint uns am günstigsten, wenn man bei *Ulcus perforans* eine Exzision des Geschwürs vornimmt und an denjenigen Fällen, die später Beschwerden bekommen, sekundäre Resektion.

### Summary.

The author gives an account of 200 cases of *ulcus perforans* between the years 1930—1944. Of these 33 (15 %) have died. Mortality for men has shown a steady decrease. In the 5-year groups 1930—34, 1935—39, and 1940—44 it was 21, 11.1 and 8 % respectively. On the other hand it has remained more or less unchanged for women — approximately 40—50 %. The author discusses the problems connected in this respect. He points out the considerable preponderance of men (88 %) over women (12 %).

The author shows that simultaneously with an increase in the

total number of ulcer perforations during the 5-year periods mentioned above, the perforation frequency, calculated percentually to the combined number of operated cases of ulcus (perforated + unperforated sores which have been subjected to resection or possibly a G. E. Operation) have decreased considerably.

The most important factors for prognosis are discussed, namely the age of the patients and the time elapsing between perforation and operation and, in this connection, the author has arrived at the following conclusions:

1) Prognosis within 6 hours after perforation is now relatively good but is considerably poorer if the patient is over 60 years of age.

2) Prognosis between 6 and 24 hours after perforation is now relatively good if the patient is under the age of 40.

3) Prognosis is very poor for perforations of more than one day's duration even in young patients.

4) Prognosis is considerably worse for women than for men.

Further, the author gives an account for the time of illness prior to the perforation and shows that 13 % of the cases have perforated without any previous symptoms of ulcus. Some diagnostic points are expounded. 150 patients have been examined radiographically with due account to the presence of free gas in the abdominal cavity. 34 (23 %) of these have been negative.

The methods of operation used have, for the most part, been raphe (in 140 cases) or excision (38 cases) with eventual Witzel-fistula (in 122 cases). Primary resection has been resorted to in 3 cases only. In his post examinations the author finds that frequency of relapse is greater (62 %) in those cases where mere closure of the sore has been carried out as against 46 % where excision of the sore has been performed. Therefore it would seem that excision of the sore is more preferable. 167 cases have survived perforation of which 10 have subsequently died. Of the remaining 157 cases, 121 have been re-examined. 43 % of these were in good health or fully capable of working. 57 % had considerable ulcus trouble. From the latter group, 46 cases have undergone resection with one death (2.2 %). Prognosis seems to be most satisfactory if, in cases of ulcus perforans, one performs an excision of the sore and secondary resection on those cases who have subsequent trouble.

### Résumé.

Deux cents (200) cas d'ulcères perforés de l'estomac ou du duodénum portant sur les années 1930 à 1944 ont été grevés d'une mortalité de 16.5 %. Il y a une différence remarquable entre le nombre des hommes (88 %) et celui des femmes (12 %). Pour les premiers la mortalité a été en dégression régulière d'un lustre à l'autre, étant de 21 % de 1930 à 1934, de 11 % de 1935 à 1939, de 8 % de 1940 à 1944. Pour les femmes, en revanche, le taux est pratiquement resté sans changement (entre 40 et 50 %). Les problèmes que cela soulève font l'objet d'une discussion. — Les facteurs les plus importants dont dépend le pronostic sont l'âge du malade et le temps écoulé entre la perforation et l'opération. L'auteur tire les conclusions suivantes:

1) Jusqu'à 6 heures après la perforation le pronostic est généralement bon sauf pour les sujets de plus de 60 ans.

2) Entre 6 et 24 heures il est relativement favorable pour les malades de moins de 40 ans.

3) Si la perforation date de plus de 24 heures il est très mauvais même chez les jeunes.

Treize pour cent (13) des cas eurent leur perforation sans avoir présenté antérieurement de symptômes d'ulcère. 150 malades furent examinés aux Rayons X pour voir s'il y avait, dans la cavité péritonéale, du gaz libre, et celui-ci fut découvert dans 116 cas (77 %). — Les méthodes opératoires de traitement ont été: 1) La simple suture de l'ulcère, 140 fois. 2) Son excision, 38 fois. 3) La résection partielle de l'estomac, 3 fois. Le drainage temporaire de l'estomac fut utilisé dans 122 cas. — Des 167 malades qui survécurent à l'opération, 10 moururent plus tard. Deux de ces dix décès furent causés par une récurrence de l'ulcère. A 121 sujets on a demandé, par le moyen d'un questionnaire, des renseignements sur leur état actuel. Parmi eux 52 (43 %) étaient complètement rétablis, et 69 (57 %) accusaient des troubles gastriques considérables. Chez 49 de ceux-ci une seconde opération eut lieu. La résection partielle de l'estomac fut pratiquée dans 46 de ces cas. Un seul ne survécut pas à l'intervention (2.2 %). La durée d'observation a varié entre 15 mois et 16 ans. — Le pronostic, pour les malades atteints de perforation d'ulcère, semble être le meilleur lorsqu'on recourt à la simple suture de l'ulcère ou à son excision, avec résection ultérieure en cas de récurrence.

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## On Spontaneous Complete Discharge of Stones from the Gallbladder and Common Duct.

By

K. A. HULTBORN.

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In cases of gall-stones, one seldom reckons with the possibility that all the concretions might pass spontaneously; it is generally considered that, if the patients are troubled by the gall-stones, and if there are no contraindications, surgery should be recommended.

It has long been known, however, that some of the gall-stones present may pass spontaneously *per vias naturales*. According to MILLBOURN, some of the stones pass spontaneously in every other case of common duct stone. He further reports two cases, where all the stones in the gall-bladder and bile ducts had apparently passed spontaneously. In these two cases there were marked changes of chronic inflammation, but he also takes into account that spontaneous passage of all the concretions may occur in cases of a normal or slightly injured gall-bladder.

REWBIDGE states in 1937 that, for the purpose of dissolving the stones, he had given, in a series of known gall-stone cases, three grains of bile salts three times daily. A teaspoonful of olive oil was likewise fed, to furnish an adequate stimulus to empty the gall-bladder. After 9 months' treatment in two cases where previous cholecystography had revealed a number of non-roentgen-opaque concretions, all of them had disappeared and the gall-bladder functioned normally. He writes: "These observations suggest that the cause of cholesterol gall-stone formation is a bile salt deficiency; when remedied, the gall-stones disappear."

Presumably, however, these two instances are examples of the possibility that all the concretions may be pass from the gall-bladder, in these cases possibly aided by the choleretic and cholecystokinetic effect of the bile salts and olive oil.

As so few cases are recorded in which all the concretions in the gall-bladder and bile ducts have passed spontaneously, I felt it might be of interest to present some such cases observed by us.

*Case 1.* Woman aged 28, who in December 1945 had a typical attack of gall-stone and since the beginning of 1946 had had four similar attacks.

On March 18th, 1946, *cholecystography* was performed at Karolinska sjukhuset: Very faint contrast filling of the gall-bladder, which contracted after an egg meal. On examination in upright position, at the base of the gall-bladder a large number of peppercorn-sized non-roentgenopaque concretions were noted. Diagnosis, cholelithiasis.

Operation was advised, but, owing to a finger infection, was postponed. During the interval the patient had three severe gall-stone attacks.

On May 13th, 1946, operation (by the writer), viz. *cholecystectomy* plus *cholangiography* plus *exploration* and *drainage* of the common bile duct. There were no adhesions encircling the gall-bladder, which appeared normal. Nor could any concretions be palpated in the gall-bladder, the cystic or the common duct. Cholangiography showed a somewhat wider common duct than normal. The contrast fluid passed into the duodenum. Level with the junction of the cystic duct there were at least three pea-sized defects, presumably air, which had been observed to enter during the injection of the contrast medium. The junction of the cystic with the common duct was now dilated, and spoons were introduced. No concretions were found on evacuating the common duct. Probes were easily inserted into the duodenum. Drainage of the common duct through the stump of the cystic duct. Three rubber tubes were directed towards the site of operation.

*Patho-anatomical findings:* No concretions in the gall-bladder. The wall was of normal thickness. The bile appeared healthy. Very slight signs of cholesterosis. Diagnosis, mild chronic cholecystitis.

On repeated *cholangiography* on May 21st, 1946, no concretions were demonstrated.

When presenting herself at the out-patient department on July 1st, 1946, the patient was symptom-free.

*Case 2.* Woman aged 38, who in March 1943 had a typical attack of gall-stone. She was admitted to a hospital, where *cholecystography* was carried out on May 17th, 1943. The gall-bladder was of ordinary size and shape and well-filled. On examination in upright position a horizontal zone of approximately millet-sized more roentgenolucent patches, presumably representing concretions, was seen in the contrast shadow. Two hours after an egg meal the gall-bladder had completely emptied.

On account of the patient's considerable obesity and of the short history, operation was declined. On September 27th, 1944, another severe gall-stone attack. Afterwards almost constantly pain in the gall-bladder region. About October 2nd, 1944, icterus and tenderness beneath the right costal arch.

At Karolinska sjukhuset *cholecystography* was performed on October 28th, 1944: Normal contrast filling. No concretions.

On November 23rd, 1944, renewed *cholecystography*. Neither on this examination could any concretions be demonstrated in the gall-bladder. The cholesterin concretions, fully the size of a pin-head, observed on May 18th, 1943, and which then had formed a layer in the lower portion of the gall-bladder, had obviously completely disappeared.

Case 3. Woman aged 75, who since 1941 had repeatedly suffered from pain resembling gall-stone attacks. On several occasions simultaneously fever. Since October 1945 increasing trouble. Never jaundice.

At Karolinska sjukhuset *cholecystography* was done on February 6th, 1945: The gall-bladder was filled with contrast fluid in normal concentration. In it were found about five defects, scarcely pea-sized, representing concretions.

The patient was admitted to the Surgical Clinic of Karolinska sjukhuset, where renewed *cholecystography* was carried out on January 28th and 30th, 1946. Filling of the gall-bladder with contrast medium in satisfactory concentration. The gall-bladder did not contain concretions. There is no doubt that the concretions observed on February 6th, 1945, had disappeared.

This is thus a case of roentgenologically established gall-stones, where at an operation performed 2 months after the X-ray examination no concretions could be detected. In addition, two cases where at the initial *cholecystography* several small concretions had been demonstrated, but which on subsequently repeated *cholecystography* did not exhibit any evidence of concretions. In all three cases we were dealing with but small concretions.

As, according to my own experience and to that of others, a spontaneous passage of all such small concretions may evidently occur, repeated *cholecystography* is advisable, if some time has elapsed between the X-ray examination and the intended operation, especially if the patient had experienced gall-stone attacks during the interval. Further, a more conservative attitude seems to be justified in cases with small concretions and roentgenologically normal gall-bladder function.

In order to improve the prospects for the passage of the concretions, cholagogics, *cholecystokinetics* and spasmolytics should be tentatively administered in the interval. Bile salts stimulate

the bile secretion, whilst olive oil and raw yolks of egg produce emptying of the gall-bladder. Small doses of magnesium sulphate may aid by relaxing the sphincter of Oddi and favouring evacuation of the gall-bladder. Antispasmodics such as nitroglycerin, nitropent and, to some extent, papaverine and atropine open the sphincter.

### Summary.

The writer reports a case with typical gall-stone history, where cholecystography had revealed a number of small concretions, and where, at an operation performed scarcely two months later, no gall-stones could be detected. In addition, two cases are presented which, at the initial cholecystography, had showed several minor concretions, and which, on subsequently repeated cholecystographies, did not exhibit any evidence of calculi. In view of the possibility that all the concretions may pass spontaneously provided they are small, if some time has elapsed between cholecystography and intended operation, X-ray examination should be repeated, especially if gall-stone attacks have occurred in the interval. In cases with small concretions and normal gall-bladder function, conservative treatment for some time, viz. choleretics, cholecystokinetics and spasmolytics, may be indicated.

### Zusammenfassung.

Verf. berichtet über einen Fall mit typischer Gallensteinanamnese, wo die Cholezystographie mehrere kleine Konkrementen nachwies, und wo bei einer knappe 2 Monate später vorgenommenen Operation keine Gallenkonkremente zu finden waren. Ferner werden 2 Fälle wiedergegeben, die bei der ersten Cholezystographie mehrere kleine Konkrementen aufwiesen, bei später wiederholten Cholezystographien hingegen keine Anzeichen von Steinen zeigten. Im Hinblick darauf, dass alle Gallenkonkremente, wenn sie klein sind, spontan abgehen können, muss man, wenn zwischen der Cholezystographie und der geplanten Operation einige Zeit verstrichen ist, erneute Röntgenuntersuchung vornehmen, ganz besonders falls in der Zwischenzeit Gallensteinanfälle vorgekommen sind. Bei Fällen mit kleinen Konkrementen und normal fungierender Gallenblase kann eine Zeitlang gegebene konservative Behandlung mit Choleretika, Cholezystokinetika und Spasmolytika indiziert sein.

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## Drainage in Operations on the Bile Passages.

By

HROAR HALDBO.

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The question of drainage may not be one of the most important ones in surgery of the bile passages, but it is by no means insignificant. Moreover, no doubt, superfluous amounts of drainage are still employed in many clinics. It will be appropriate therefore in the following to touch on some of the problems connected with this question and at the same time to review a material that will serve to elucidate it.

It is to be emphasized at once that here we shall not be dealing with the more complicated operations employed, for instance, in stenosis of the choledochus, but only the drainage in the more common operations on the bile passages.

Speaking of drainage, of course, we have to distinguish between the drainage — rubber drain, cigarette drain, meshes etc. — after cholecystectomy and the choledochus drainage. The material of the department will be reviewed with regard to these two categories, and the favourable or injurious effect of the drainage will be estimated from their operative mortality, the post-operative course and complications, besides the final results. The material of this department from 1927—1937 is included in the review, in spite of differences in the two materials, because, among other things, the significance of the question is to be elucidated also as far as the late results are concerned — and here we have just a period in which enormous amounts of drainage and constant choledochus drain were employed.

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It is to be emphasized at once that here we shall not be dealing with the more complicated operations employed, for instance, in stenosis of the choledochus, but only the drainage in the more common operations on the bile passages.

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When surgeons hesitate in closing the wounds primarily in such operations, it naturally is due to the following two reasons:

1) Very often the operation has to be performed in an infected field; and

2) there is a risk of bile oozing from the stump of the cystic duct, from the bed of the gall-bladder, or from the choledochotomy.

The first of these factors — the infection — is not very likely in itself to play any particular rôle. The peritoneum possesses a great capacity for dealing with inflammatory processes when the source of infection is removed. In connection with oozing of the bile, on the other hand, it is a serious matter, involving a great risk of diffuse peritonitis. The risk involved in biliary peritoneum is well known; at any rate in a great many cases it leads on to symptoms of peritonitis and severe intoxication, paralysis etc., whereas a small amount probably may become encapsulated and absorbed.

The surgeons are still very far from agreeing about the risk of biliary oozing from the various parts. With careful treatment of the stump and peritonealization, the risk of oozing from the cystic stump is only slight. As to the bed of the gall-bladder, we have to take into consideration that in many cases several fine bile ducts — in rare cases, also larger ones — open directly into the gall-bladder. This fact, then, means the presence of a risk in a certain number of cases. Finally, as far as choledochotomy is concerned, we all know that it is difficult to close this incision so precisely as to exclude any oozing of bile — even after peritonealization.

Our problem may fittingly be formulated in this way: Is drainage useful, injurious or indifferent?

Drainage is employed to delimit an inflammatory process, remove exudate, divert the oozing of bile, drain the bile passages in cholangitis and, finally, act as a safety valve if some choledochus stones be left behind. Indeed, choledochus drain is said to be employed also for secondary cholangiography.

It might seem bold to omit the choledochus drain after choledochotomy, but experiences have shown that this may be done (*e. g.*, MIRIZZI, PRIBRAM, THOREK).

All surgeons, who recommend the primary suturing in choledochotomy together with peritonealization agree that the first condition for the employment of this method is free passage through the choledochus — *i. e.*, no remaining stones, no stenosis,

a normal pancreas, and a normal Vater's papilla. It is obvious that cholangiography (MIRIZZI 1931) may be of great value by establishing whether these conditions may be fulfilled. No doubt, the dilatation of the papilla, with which most surgeons conclude the choledochotomy, is also of great value to the outcome.

On the other hand, probably the presence of cholangitis plays merely a minor rôle as long as the passage through the choledochus is free. In this connection, it means a great deal that bacteriologic examinations have shown that in many cases the choledochus bile keeps sterile even when the cystic duct and the wall of the gall-bladder are infected. But as soon as there is a stone in the choledochus, the bile in such cases will most often be infected — as pointed out by MIRIZZI, who arrived at the conclusion that the choledochus bile undoubtedly soon becomes sterile again, once the stone and obstruction are removed.

The noxious effect of the drainage may be summed up as follows: prevention of the normal physiological processes of delimitation — indeed, complete collapse of the operative field is precluded by drainage — possibility of shock, increase in gastric and intestinal atony. Besides, choledochus drainage diverts the normal bile secretion from the organism — which is rather likely to be of some significance, at any rate, to debilitated patients — and with protracted oozing fistulae it may become a serious matter ("the drainage should follow natural ways", it is claimed). Stenotic processes in the choledochus may arise from traumatic injury by the drain, associated with lacking flow of bile distally to the drain. For these reasons, several surgeons — among others, KIRSCHNER — have given up the routine employment of choledochus drainage. Mention is to be made also of the risk of infection through the drain. At any rate, this risk has to be reckoned with in secondary cholangiography.

Finally I wish to point out the inconvenience to the patient implied by the drainage: it prolongs the postoperative stay in the hospital; its removal gives discomfort or pain; and even a rubber drain may cause some discomfort reminding of gallstones.

As to the mentioned risk of stenosal processes in the choledochus, it undoubtedly is exceedingly slight. WALTERS states that in his material of 80 cases of choledochus stenosis treated operatively no less than 77 had developed post-operatively — and in 77 % of these cases the lesion had appeared after cholecystectomy — *i. e.*, the lesion is due to an injury produced by



the surgeon. LAHEY, holding the same view, states that it is a panic injury most often due to arterial hemorrhage during the operation and ensuing groping with hemostates etc. Instead of this, the hemorrhage may be stopped by simple compression of the hepatic artery with a finger in the foramen of Winslow.

All told, then, there are several points suggesting that it is advisable in most cases to omit any voluminous drainage with gauze and similar means as well as drainage of the choledochus.

Sufficiently large materials have made it evident that in many uncomplicated cases it is safe to close the wound primarily. But this requires that several conditions are met: subserous removal of the gall-bladder, careful and reliable closure of the cystic stump and complete peritonealization of the cystic stump and the bed of the gall-bladder.

PRIBRAM and THOREK recommend primary closure also in cases where the gall-bladder could not be removed subserously on account of infection. PRIBRAM employs cauterization of the mucous membrane of the gall-bladder and suturing of the margins; with very careful peritonealization. THOREK employs electrocoagulation of the gall-bladder wall, suturing of the margins, and covering of the field with free transplantation of the falciform ligament. The results reported from the two clinics are good. The methods have not been adopted generally as a routine method, but electrocoagulation is often applied to an inextirpable remnant of a strongly infected gallbladder.

THOREK goes as far as to claim that many of the patients died from the drainage, while the advocates of draining natural assert the opposite. In this country, KJÆRGAARD has objected to the omission of drainage on account of the risk of biliary peritonitis. It is further to be mentioned that some surgeons no longer employ primary closure to the same extent as before (*e. g.*, v. HABERER cit. ORATOR). Among other surgeons taking part in the discussion of this question it is merely to be mentioned that BAKES states that in 346 cases of cholecystectomy no less than 230 showed oozing of bile for a few days — in spite of careful ligation of the cystic stump and subserous removal of the gall-bladder. As will be pointed out later, this is in conflict with our experiences.

As far as that goes, the serviceability of a given method has to be estimated on the basis of the operative mortality, the post-operative course of the cases, the complications arising, and finally, the late results. Here, then, it will be appropriate briefly to

review our material of such cases with a view to these particular aspects.

In our department, from its opening in 1927 to the end of 1945 altogether 539 operations were performed for cholelithiasis and cholecystitis. During the first 10 years of this period (in 176 cases, while Dr. HELSTED was surgeon-in-chief) an enormous drainage was employed, with numerous gauze strips and drains. Since 1937 (when Professor MORVILLE became surgeon-in-chief — altogether in 363 cases) the drainage has been very scanty.

In the first period the lethality was very high (21 %). Here it is to be mentioned that in this period the surgeon-in-chief rather hesitated in operating for cholelithiasis and insisted upon strong indication for operative treatment. So many of the cases in this period have been rather serious, and this has contributed to the high mortality. Also for other reasons the two groups of cases are not comparable. Thus, among other things, in the latter period lumbar anesthesia has been employed regularly, while in the former period the patients were operated on under universal anesthesia. Still, it is just on going through the material from the former period that we find some points that have to be emphasized: 1) neither the development of peritonitis nor hemorrhage from the operating field is prevented by voluminous drainage; 2) further one patient died after intestinal prolapse following the removal of the drainage, and another patient died after 4 weeks with biliary fistula, without any gallstones being left; the number of "unexplainable" deaths was very high, most of them falling under the term of "shock", and at any rate it cannot be excluded that the amount of drainage played a part in these deaths, while bronchopneumonia and atony may also have been a cause of the fatal outcome. On the other hand, it is to be mentioned that cholascos was not seen in any of these cases.

After this, we may turn to the material from the period of 1937—1945.

We will consider first the technical principles of the operation. No operation has been performed at the acute state of the inflammation. The procedure has consisted in subserous removal of the gall-bladder from the cystic duct after division of the peritoneum and thorough orientation of the anatomical conditions concerning the cystic, hepatic and common bile ducts; choledochotomy after the usual indications (history of jaundice, dilatation of the choledochus, small stones, wide cystic ducts, etc.); primary closure

of the choledochotomy, catgut ligation of the cystic stump, and finally a careful peritonealization over the deep bile passages and the bed of the gall-bladder. If the gall-bladder cannot be removed by good clivage, a remnant of the gall-bladder is often left for electrocoagulation and suturing of the margins. The drainage is practically limited to a cigarette drain exclusively; and this is not placed in close apposition to the site of the suture; besides, it is removed 3 days after the operation. Choledochus drainage has been employed altogether only 9 times, and in the last two years the wound has been closed primarily in 37 cases, all with an uneventful postoperative course. The results are recorded in Tables 1 and 2.

Table 1.  
1937—1945.

	Discharged:	Died:
Cholecystectomy (182) .....	177	5 ( 2.7 %)
Choledochotomy (172) .....	158	14 ( 8.1 %)
Cholecystostomy (9) .....	6	3 (33 %)
Total (363) .....	341	22 ( 6.1 %)

Table 2.  
1941—1945.

	Discharged:	Died:
Cholecystectomy (132) .....	131	1 (0.8 %)
Choledochotomy (150) .....	140	10 (6.6 %)
Cholecystostomy (3) .....	2	1
Total (285) .....	273	12 (4.2 %)

Table 3.  
*Cause of Death.*

Peritonitis .....	6 Cases
Perihepatic abscess .....	2 »
Lung-heart lesions .....	2 »
Liver lesion .....	2 »
Ileus .....	1 »
Hepatorenal syndrom .....	1 »
Shock .....	2 »
Technical error .....	3 »
Cholecystostomy .....	3 »

The results will be evident from Tables 1 and 2. In Table 2 the cases from the last five years have been recorded separately, among other reasons, because the methods may be said here to have

been firmly established. It will be noticed that explorative choledochotomy has been employed to a very large extent, which is not insignificant to the total mortality, and now indeed it is employed more infrequently.

The causes of death are given in Table 3. It is to be mentioned that in all cases where only a relatively mild degree of peritonitis was found and no other demonstrable cause of death, the death has been attributed to peritonitis.

The three instances of technical error are: 1 case of postoperative hemorrhage, 1 case of ligation of the hepatic artery, and 1 case in which the hepatic duct and choledochus were ligated. The last patient died on relaparotomy, 18 days after the first operation.

The question now arises whether a possibly insufficient drainage may have been responsible for any of the 8 cases of local or diffuse peritonitis.

As far as cholecystectomy is concerned, we can see no reason why we should modify the operative principles adopted. (Mortal: 0.8 %). As to choledochotomy, it may be that we have been too categorical in omitting choledochus drainage. Diffuse cholangitis was revealed in one patient who died 9 days after the operation. Autopsy disclosed a leakage from the choledochus; and no stones were left. As the postoperative course in this case was uneventful during the first days, it may be that the drain had been adjacent to the choledochotomy and that its removal had brought about a tear. In 3 patients there was a little bile-colored fluid round the operative field and a more or less diffuse peritonitis. In all these patients the operative field had been strongly infected; the peritoneum was infiltrated and stiff; and the peritonealization over the bile passages was incomplete. It may be that in such cases, for the sake of safety, the choledochus drain should be employed; but, in particular, choledochotomy should be limited to what is absolutely necessary. It is to be kept in mind that cholecystitis may give symptoms that generally are taken as indication for choledochotomy.

As to the patients discharged from the hospital (altogether 341), the postoperative course has been nearly or completely uneventful in 93 %. Biliary fistula was seen only once — after cystostomy performed as an emergency operation; later the patient was submitted to a radical operation, and recovered. In one case a fairly large stone, left at choledocholithotomy was passed

spontaneously a few months later; in this case the immediate postoperative course was uneventful. Pleurisy or pneumonia occurred in 12 cases. Finally, in 5 cases a subsequent incision was made with a view to the possibility of an intraperitoneal abscess, with negative result in 2 of the cases.

One feature is to be mentioned in particular, namely: as far as we have been able to ascertain, there has never been any oozing of bile from the cystic stump after cholecystectomy. Only in 2 cases was there a little bile in the bandage on the first day after the operation; and in both of these cases the parenchyma of the liver has been bared in the bed of the gall-bladder.

It is for this reason that I stated that the risk of oozing from the cystic stump is only slight. On the other hand, in one patient on whom, besides cholecystectomy, choledocholithotomy has been performed too, there was a protracted oozing from the cystic stump. The patient died 2 months later from renal complications after an operation for ileus. On autopsy the choledochus was found to be filled with mushy bile.

As far as that goes, after choledochotomy the bandage is commonly soaked with bile on the first day.

Disturbances of the intestinal function were practically never seen in this material. The duration of the postoperative stay in the hospital is evident from Table 4.

Table 4.

*Postoperative Stay in Hospital.*

1927—36 .....	39	days
1937—45 .....	19	»
1941—45 .....	17.4	»
Undrained (37) .....	13.4	»

As to the last point — the late results — owing to the defective state of the registers of the population since the war, the follow-up examinations are far from complete. Of the present material, only 200 patients have been reexamined, but, on the whole, the results are in keeping with those reported by previous investigators. As far as can be seen, there is no evidence to the effect that the operations in the first period might have given rise to more complaints than those in the second period, so in this respect, drainage appears to play a minor rôle.

In 57 reexamined patients from the first period, a hernia was present in 4 cases, while in the second period hernia was

found in 4 out of 136 reexamined patients. So the oblique incision employed in both periods appears to be a favorable incision that does not give rise to many instances of hernia.

Our material justifies the following conclusion:

After "ideal" cholecystectomy no drain is required. After all cholecystectomies a cigarette drain for 3—4 days is sufficient. Choledochus drainage is superfluous in most cases — provided there is free passage. In certain infected cases, with stiff and infiltrated tissue, drainage should be employed.

### Summary.

In order to elucidate the question about the significance of drainage in operations on the bile passages, a material is reviewed in which the drainage has been scanty:

"Ideal" cholecystectomy is closed primarily, otherwise cholecystectomies are drained with cigarette drains for 3—4 days. Choledochus drainage is employed but exceptionally.

The last 5 years' period comprises 285 cases with a total mortality of 4.2 % — including 132 cholecystectomies with 1 death.

Thus the method here adopted is found justified. Still, choledochus drainage should be employed in certain cases.

### Zusammenfassung.

Zur Erläuterung der Frage von der Bedeutung der Drainage bei Operationen der Gallenwege wird ein Krankenmaterial durchgenommen, bei welchem Drainage wenig angewandt worden ist.

Nach "idealer" Cholecystectomie wird primär suturiert, sonst wird nach Cholecystectomien 3—4 Tage mit einem Zigarettendrain drainiert; Choledochusdrainage wird nur ausnahmsweise angewandt.

Die letzte fünfjährige Periode umfasst 285 Fälle mit einer Totalsterblichkeit von 4.2 Prozent — einschliesslich 132 Cholecystectomien mit einem einzelnen Todesfalle. Man findet die angewandte Methode daher gerechtfertigt; Choledochusdrainage ist jedoch in gewissen Fällen geboten.

## Résumé.

Afin d'éclaircir la question de l'importance du drainage après des opérations chirurgicales des voies biliaires, un matériel de malades a été examiné, dans lequel le drainage n'a été pratiqué dans peu de cas.

La cholécystectomie "idéale" implique la suture primaire de la plaie, autrement les cholécystectomies sont suivies de drainage, pendant trois ou quatre jours, au moyen d'un drain cigarette, le drainage du cholédoque ne se pratiquant qu'exceptionnellement.

La dernière période de cinq ans comprend 285 cas, avec une mortalité totale de 4.2 p. 100 — y compris 132 cholécystectomies avec un seul décès.

Ainsi, la méthode adoptée ici se trouve être justifiée. Le drainage du cholédoque devra toutefois être pratiqué en certains cas.

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## A New Method of Treating Capillary Haemangiomas.

By  
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From the anatomical point of view the haemangioma is a tumour made up of blood vessels, and consisting almost exclusively of vascular tissue. From the patho-anatomical point of view we differentiate between two types, the capillary or teleangiectatic haemangioma and the cavernous haemangioma. The haemangiomas belonging to the former type are also called haemangioma simplex. Such a tumour consists of a dense network of newly-formed capillaries, originating from the endothelial buds of the vessels. These capillaries are mostly of uniform caliber and the amount of interstitial tissue between them is as a rule comparatively small. Cavernous haemangiomas on the other hand consist of large irregularly shaped blood spaces, generally communicating with each other. They resemble when most typical the normal erectile tissue.

Capillary haemangiomas may vary considerably in size. Some are pinhead-sized, while others extend over a whole extremity or sometimes over half the body. Their colour varies from light-red to dark lilac. The difference in colour is due *i. a.* to the localisation of the haemangioma in relation to the surface of the skin, to the amount of cavernous tissue and to the number of vessels involved. The demarcation lines towards the surrounding skin are often unsharp, and dented ramifications and small fragmented portions are not seldom observed. The capillary haemangiomas are mostly localised to the skin of the face and



the neck. According to SONNTAG (1914) 75 per cent of them are localised to the face. Their distribution in the face is generally unilateral with a certain praedilection for the area supplied by the fifth cranial nerve. Some authors assume that their generally unilateral occurrence and their type of distribution is due to their relation to the course of the nerves: neuropathic angioma, while others maintain that their type of distribution is connected with the foetal facial fissures: fissural angioma (VIRCHOW).

The most characteristic trait of the cavernous haemangiomas is their capacity of changing their volume. It is typical that their volume can be greatly diminished by applying compression. Conversely a marked increase in volume is observed in case of coughing, sneezing, violent mental reactions, etc.

Haemangiomas are commonly considered to amount to 2 to 3 per cent of all tumours, and 7 per cent of the benignant growths. They are generally held to be more frequent in women than in men, although this opinion may to a certain extent be based on the fact that the cosmetic aspect of a haemangioma is sooner observed in women.

Most haemangiomas are congenital. They develop as a rule at the same rate as the part of the body to which they are localised. A higher rate of growth is sometimes observed, particularly during the first year of life. Cases of spontaneous regression of haemangiomas are described, but seem to be very rare. It is on the other hand no infrequent observation that initially separated small haemangiomas merge into larger growth when the latter increases in size. Inflammatory changes, ulcerations and thrombotizing processes are sometimes observed.

To many people malformations of this kind mean a severe mental trauma, and their desire to get rid of their deformity at any price must therefore be respected. There is further no doubt that many professions require as far as possible faultless looks.

Nowadays a cavernous haemangioma can with very good results be treated with irradiation therapy. Radium treatment is mostly given in the form of surface therapy (STRANDQVIST, 1939). Roentgen treatment in the form of contact therapy (HULTBERG, 1943, KINDLER, 1943) has now been used for several years. Very good results have here been obtained, not least from the radiological clinics in our country. It is however necessary that the cavernous haemangiomas are brought to treatment as soon as possible after birth, as the character of the vascular endothelium is markedly

embryological during the first year of life and consequently highly sensitive to radium and roentgen. Such cases where spontaneous regression of an haemangioma is said to take place are so rare that it must be considered definitely wrong not to send these patients to be treated at a radiological clinic as soon as possible.

The indications for treatment of capillary haemangiomas are almost exclusively of cosmetic nature. In a great study from 1914 SONNTAG discusses a very large number of treatment methods. At present the majority of these methods seem to be out of fashion or are interesting only from the point of view of curiosity. Among SONNTAG's methods may be mentioned ligature of all supplying vessels, compression treatment, etching, injection of alcohol, treatment with heat, cold, galvanic current, and excision. The most important among later additions to these methods are radium and roentgen therapy. Of all these methods — excluding the operative and the irradiation methods — it seems as if only the methods based on treatment with heat, cold or galvanic current were more extensively used. Heat treatment is performed as thermo-cauterization with different kinds of cauteries (micro-cautery, Paquelin's cautery, etc.). In most cases the treatment must be repeated, and it always leaves more or less conspicuous scars. Treatment with cold is nowadays almost exclusively performed by freezing the tumour with carbon dioxide snow. This method is applied in many clinics with apparently good results, although leaving, as like as the former method, a rather conspicuous scar. Operative treatment of haemangiomas is performed in many different ways. Some have for instance experimented with perforating the tumour with fine metal needles which have been dipped in an acid. Scarification has been made in the form of closely placed surface incisions, often in combination with etching dressings of lapis- or ferrichloride-solutions. Excision of the epidermis and the top layer of cutis by means of a microtome is also described. The most radical method is of course excision of the whole haemangioma. In cases of large capillary haemangiomas this is often technically impossible, however, but in such cases where the method can be applied, it seems to yield excellent results.

Neither are the results of radium or roentgen therapy very encouraging. The capillary haemangiomas are comparatively resistant to radiation, possibly because of their histological character with highly differentiated cells. Technically, too, the treat-

ment is fairly difficult, as the often large surfaces cannot be treated simultancously, for which reason the treatment must take place in séances on several fields. This often results in some untreated lines remaining afterwards, which makes the final result unsatisfactory. Using radium therapy on a material of 76 cases from Radiumhemmet, Stockholm, ANDRÉN (1927) did not obtain satisfactory results in any case. Contact therapy, too, has been tried (KINDLER 1943, HULTBERG 1943) though the method has perhaps not given the expected results. Apart from excision the results of the methods enumerated above have thus been such that most authors are of the opinion that capillary haemangiomas had better be left untreated.

During the last two years, 17 cases of capillary haemangioma have however been treated at Eksjö Hospital with an exceedingly simple and as regards the cosmetic final results also quite satisfactory method. In the literature available at present I have not been able to find any hint as to whether this method has been used previously. It consists quite simply in trying to remove or destroy the capillaries in the surface layers of the skin by means of rubbing the haemangioma with sand-paper while leaving the subcutis intact.

The treatment is performed under infiltration anaesthesia. This is administered liberally: 1 per cent novocain, to which one drop 1 pro mille exadrine is added per 10 ml of novocain solution. The novocain is injected in such a way that a firm oedematous skin cushion against which to work is obtained. The rubbing is then performed with ordinary sterilised sand-paper of sizes varying from No. 2 to No. 5. In such cases where the haemangioma has been relatively large and the substructure plane, it has often been found advantageous to use small wooden blocks covered with sandpaper. When rubbing regard must be payed to the borders of the haemangioma so that as little rubbing as possible is made outside them. The bleeding is profuse, and compression must be applied the whole time. The rubbing must be performed very carefully in order not to penetrate too deep down in cutis, and the subcutaneous fat should never be visible.

All the cases in this material except No. 12 have been treated in one séance. Infection has not occurred in any case. After the rubbing the sometimes very large wound surfaces have been covered with a dressing with a lot of sulfatiazol in sterile substance. The dressing has not been changed until after 5 to 6 days, when

it has been exchanged for an unguent dressing with sulfatiazol salve. Complete healing has always taken place within 10 days. Care must be taken to prevent folds of the skin being formed when the dressing is applied, as this may give rise to coalescences which necessarily will spoil the cosmetic result completely. The 17 cases in the present material have all belonged to the type haemangioma simplex except in a couple of cases with certain cavernous elements. The table shows that the size of the haemangiomas has varied within very wide limits.

Some photographs are included to illustrate the results. It is evident that the results can be characterized as good, and all the patients except one have been satisfied. The exception, case No. 3 in the table, had a haemangioma 2 by 4 cm in size of capillary type on one cheek. Its colour was fairly red. When compressing and stroking the haemangioma with the finger it was impossible to achieve that emptiness of blood which appears to be necessary if the result shall be satisfactory. The treatment was performed in the way outlined above, but it was necessary to work fairly deep down into cutis in order to get it pale. Healing took place within 10 days, but it was obvious already when the patient was discharged from hospital that the result was not favourable. The treated area had paled markedly, but contrasted still definitely with the surrounding skin. When controlled one year later there was a border zone of pigment-free skin round the treated angioma; this zone contrasted strongly against the patient's otherwise pigment-rich skin. The result can possibly be explained by the fact that the operator when performing the rubbing had not kept strictly within the limits of the haemangioma, so that areas outside it had been rubbed, too.

All cases of capillary haemangioma are not equally well suited for this treatment. The best results are obtained if the colour is the darkest possible red, preferably with a tinge of blue. The lighter type is least suited for it. The size is of no importance. It seems on the other hand as if it were necessary that the haemangioma is easily emptied of blood by compressing and stroking it with the finger. If it is difficult to empty a haemangioma of blood, or if great force has to be applied to do this, the angioma is probably too deeply situated to be suited for this kind of treatment.

It does not seem to play any particular rôle if an angioma is slightly cavernous, and even if a small varix ruptures this.

does apparently not have any effect on the final satisfactory result.

A profuse anaesthesia should be given so that a firm oedematous cushion against which to work is obtained; even in such cases where narcosis has been necessary, local anaesthesia has been given in order to reduce bleeding. The coarseness of the sand-paper to be used is decided from one case to the other. If the underlying part consists of a bone ridge, *e. g.*, the frontal bone, the malar bone, etc. there is a risk of penetrating into subcutis.

The rubbing should be performed without too much pressure, and if no result can be perceived after rubbing the angioma a couple of times, the whole attempt must be considered useless. In any case the result will then probably be cosmetically worse than before the treatment began.

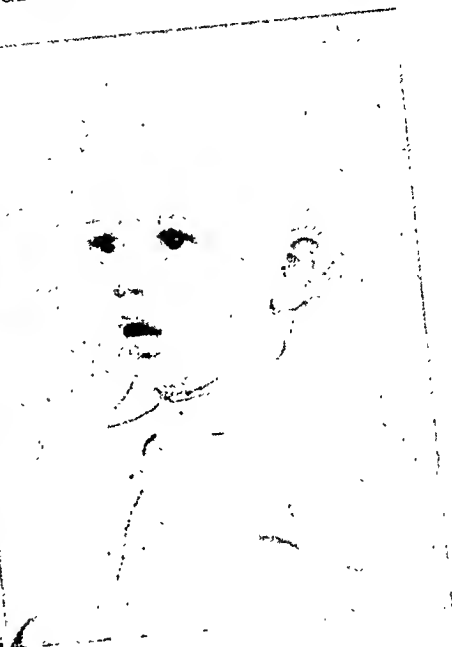
Among the 17 treated haemangiomas 10 were of the dark-red type; all these cases gave very good results. The photographs of cases 15, 17, 10 and 12 give some idea as to the effect of the treatment. The results with angiomas of the lighter type have not been so satisfactory. It is not easy to determine the exact reason why this is so, but I have the impression that the purplish haemangiomas are more superficial than the lighter ones. When treating the dark angiomas considerably less injury to the skin has been required to obtain a good result. The effect of a slight compression of a haemangioma gives a certain idea of its susceptibility to treatment. If an angioma is emptied of blood when being slightly compressed with the finger or with a glass spatula, it has been found to respond favourably to treatment.

It can be seen from the table, too, that the 7 haemangiomas of the brighter type have not given so good results. It is true that they have paled very markedly, but the treatment has in all these cases had to be applied more intensively than in the darker cases. During the actual treatment I also got the impression that the darkly coloured haemangiomas were more loosely built than the brighter ones, which seem to be more compact in structure.

Healing has generally taken place in very short time which must be regarded against the background of the good nutrition of the skin of the face. An infection of the treated skin would necessarily endanger the final result, and especially with children a greater care than usual must be taken to prevent it.



Case 15, 1 year.  
Operation 7. 6. 1944



Case 15.  
Control photograph 25. 9. 1944



Case 17. 42 years.  
Operation February 1944



Case 17.  
Control photograph July 1944



Case 10, 47 years.  
Operation 12. 4. 1944



Case 10.  
Control photograph 20. 8. 1944



Case 12. 37 years.  
Operation 8. 5. 1944



Case 12.  
Control photograph 24. 9. 1944

Table 1.

	Sex	Age.	Size and localisations	Colour	Result
1	Man	36 years	Very large haemangioma over the left eye towards the ear and up in the hair	Fairly bright red	Good
2	Woman	56 "	Two penny-sized haemangiomas in the forehead on the right side	Dark-red	Excellent
3	Man	32 "	2 by 4 cm on the outer edge of the left cheek	Fairly bright red	$\frac{1}{2}$ em pigment-free zone round the moderately improved haemangioma
4	Man	28 "	2 by 4 em on the outer edge of the left cheek	Bright red	Good
5	Woman	33 "	Right half of the face except eyelid; mixed type: cavernous-capillary	Fairly bright red	Moderate
6	Woman	15 "	Shilling-sized haemangioma on the cheek + penny-sized on the chin	Bright red	Moderate
7	Woman	$\frac{1}{2}$ "	1 by 1 cm haemangioma on the chin	Dark-red	Excellent
8	Woman	2 "	$1\frac{1}{2}$ by 3 cm on the cheek	Bright red	Moderate
9	Woman	15 "	Penny-sized haemangioma in the forehead	Dark-red	Excellent
10	Woman	47 "	Penny-sized haemangioma on one cheek	Fairly dark-red	Excellent
11	Man	45 "	Angioma of mixed type over the right eye towards the hair, about 5 by 5 cm, and on the upper eye-lid	Dark-red	Excellent
12	Woman	37 "	Very large haemangioma on the right side of the neck up to the ear and slightly above the mandible	Dark-red	Good
13	Woman	41 "	About shilling-sized haemangioma, under the right eye of mixed type	Dark-red	Good
14	Woman	48 "	Below the ear on the neck and partly on the anterior part of the chin Haemangioma	Dark-red	Good
15	Man	1 "	$\frac{1}{2}$ by 1 cm on the cheek with a cavernous tip	Dark-red	Excellent
16	Woman	40 "	Below the eye, 3 by 3 cm, mixed type	Dark-red	Excellent
17	Woman	42 "	Below the eye, 2 by 3 cm, capillary type	Bright red	Good

As all the available data regarding the treatment of capillary haemangiomas with previously employed methods are rather discouraging, and as several authors prefer to advise against any



treatment of these types of haemangioma, the present method appears worthy of mentioning. Although the results of this treatment have not been completely satisfactory in all cases, they have nevertheless made it evident that it deserves of being applied to a greater number of cases.

As most of the patients do not live within the immediate vicinity of the hospital, the after-examination has in some cases not been such as would have been desirable. However, the great majority of the patients have informed us, by letter and telephone calls, that the results have been stationary 1 to 2 years after the treatment was performed. As no case was treated with this method before 1943, the observation time does not exceed 2 years.

The method is simple and can be performed at the Out-Patient's Department. It is painless, and the equipment is the cheapest possible. The after-treatment must be very carefully supervised, however, and infection must absolutely be prevented.

In our material we have not observed any disadvantages or complications of this treatment.

Cavernous types of angioma should not be treated in this way. This stands out clearly already from their histological structure, and excellent results have further been obtained in such cases by means of radium or roentgen therapy.

On the other hand the capillary haemangiomas are, as shown above, more or less sensitive to this kind of therapy, and as the most disfiguring and most conspicuous of them, the purplish ones, yield the best results, our method must be considered a positive improvement on those previously used.

### Summary.

Various types of haemangioma, their patho-anatomy and the types of therapy used up to now — none of which has yielded completely satisfactory results — are briefly surveyed. A method is then described which has been employed for the last two years at Eksjö hospital. It consists quite simply in rubbing out or destroying the haemangioma with ordinary sand-paper. The treatment is performed under local anaesthesia. It has been applied to 17 cases, with good or completely satisfactory cosmetic results in 13 cases. The treatment is simple, painless, and the equipment required the cheapest possible.

### Zusammenfassung.

Nach einer kurzen Durchsicht der Hämangiomtypen, ihrer pathologischen Anatomie und der bisher verwendeten Behandlungsmethoden, die alle keine voll befriedigenden Resultate gegeben haben, teilt Verf. eine in den letzten 2 Jahren im Kreis-krankenhause Eksjö verwendete Methode mit. Diese besteht ganz einfach in einem Ausreiben oder Zerstören des Hämangioms mit gewöhnlichem Sandpapier. Die Behandlung wird in örtlicher Betäubung vorgenommen. 17 Fälle sind behandelt worden, darunter 13 mit gutem oder vollgutem kosmetischem Ergebnis. Die Behandlung ist einfach in der Ausführung, schmerzlos und das Instrumentarium das denkbar billigste.

### Résumé.

Après avoir brièvement passé en revue les divers types d'hémangiomes et leur anatomie pathologique, ainsi que les traitements qui leur furent appliqués jusqu'ici — traitements dont aucun n'a donné des résultats parfaits — l'auteur communique une méthode qui a été employée ces deux dernières années à l'Hôpital d'Eksjö. Elle consiste tout simplement à effacer ou détruire l'hémangiome avec du papier de verre ordinaire, et ce, sous anesthésie locale. 17 cas ont été traités de la sorte, dont 15 avec des résultats cosmétiques bons ou parfaits. Ce traitement est facile à appliquer, indoloreux, et l'instrumentation requise est la moins coûteuse qui soit.

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## Postoperative Emptying Difficulties in Direct Connection with Gastric Resection.

By

IVAR R. SANDBERG.

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The frequency of emptying difficulties after operations for gastric ulcer varies considerably according to different reports. Some surgeons state that they have hardly ever found such complications, whereas others give a frequency figure of fully 5 per cent. severe cases. According to PERMAN's Swedish statistics for the five years' period 1923—27, the figures are somewhat higher for resection according to Billroth I than for Billroth II, whilst the cases of gastroenterostomy hold an intermediate position.

A number of explanations of these emptying difficulties have been given. The stated causes may be divided into two groups, namely 1) mechanical and 2) functional. As the theories and practical observations of the different authors have previously been dealt with in this journal in detailed reports by PERMAN (1935) and BRANDBERG (1945), merely a few of the cases we have had at the Surgical Department of Karolinska sjukhuset and the conclusions we have drawn from them will be reported here.

*Case 1.* K. 3292/42. Man aged 57, with *ulcus callosum ventriculi*. On the 7th December resection was made, with retrocolic gastroenterostomy to the upper two-thirds of the gastric cross section. The mesocolon was scarred, shrunken and difficult to pass through. The patient used an indwelling nasal catheter into the stomach the whole postoperative time. The blood chemistry was kept normal. The stomach did not appear to empty; x-ray examination a fortnight after the operation showed a considerably dilated stomach, and no passage through the gastroenterostomy occurred in two hours, although the patient assumed a half-sitting or sitting posture. On the following day

relaparotomy. The entire gastroenterostomy area was converted into a thick infiltration and, on gastrotomy, the opening was found to consist of an indurated channel of finger breadth, 4 cm in length. An anterior gastroenterostomy, together with a Witzel fistula into the stomach, was established. The patient died of peritonitis 26 days after the second laparotomy. The postmortem showed a leakage of the suture line in the anterior gastroenterostomy and, what is most interesting in this connection, the gastroenterostomy first formed, which was previously a stiff narrow tube, had healed and admitted 2—3 fingers.

*Case 2.* K. 134/43. Man aged 53, with a duodenal ulcer. Resection according to Billroth II with retrocolic gastroenterostomy to the whole gastric cross section. Emptying difficulties from the second day. X-ray examination 8 days after the operation (see Fig. 1 a) showed a very slight passage through the gastroenterostomy  $1\frac{1}{2}$  hours after the contrast meal had been given, and after another 4 days still no passage worth mentioning. Relaparotomy was performed 12 days after the resection. Many adhesions in the upper part of the abdomen. The greater omentum was rolled into a very hard string, four finger-breadths in thickness. The transverse colon was drawn dorsally, the mesocolon seemed shrunken and numerous small intestine loops were adherent to its under side. They were loosened. The gastroenterostomy was palpated through an opening in the stomach and scarcely admitted the fingertip. An anterior gastroenterostomy was formed, together with an enteroanastomosis. After this operation still no improvement; x-ray examination 8 days after the relaparotomy (Fig. 1 b) showed merely a slight passage even after 45 minutes. As the anterior gastroenterostomy was made wide, the obstructed passage could scarcely be due to stenosis but must be attributed to gastric atony. For feeding purposes a jejunostomy was formed 10 days after the second operation, and in course of time (after bilateral pulmonary embolism) the whole trouble cleared. X-ray examination one month after the formation of the fistula showed a normal passage, first to the posterior gastroenterostomy originally formed (Fig. 1 c) and afterwards also through the anterior one (Fig. 1 d).

*Case 3.* K. 1641/45. Man aged 47. Duodenal ulcer. Typical resection according to Billroth II was made with a retrocolic terminolateral gastroenterostomy. The patient used an indwelling nasal catheter into the stomach for 3 days and the sequel was uncomplicated, so that he could be discharged 13 days after the operation. Some time after returning home he felt sick, and vomited remnants of food. He returned to the Surgical Out-Patient Department 1 month after the operation; x-ray examination then showed (Fig. 2 a) a narrow stoma and a considerable gastric retention. The patient received prostigmine, was put on a dietary regime and gradually became free from trouble. X-ray control  $3\frac{1}{2}$  months after the operation (Fig. 2 b) showed a broad gastroenterostomy, and evacuation proceeded rapidly, as is usually the case after resection according to Billroth II.

*Case 4.* K. 931/44. Woman, aged 54. Duodenal ulcer. The patient was stout, with a marked layer of fat in the omentum and mesocolon. Resection according to Billroth II with retrocolic terminolateral gastroenterostomy to the lower two-thirds of the cross section. The resected part along the greater curvature measured 23 cm. The patient used an indwelling nasal catheter into the stomach for 2 days and the sequel seemed to be uncomplicated; she was up, ate, drank and felt well until 11 days after the operation, when she vomited 700–800 ml of yellowish-brown fluid. The patient was then free from trouble for 5 days, when she again had a severe attack of vomiting. X-ray examination 20 days after the operation showed a marked dilatation of the remainder of the stomach (Fig. 3 a) and an extremely slow evacuation (Fig. 3 b). The patient was treated with prostigmine, 0.5 mg twice daily for 10 days, and in course of time became practically free from symptoms. Control x-ray examination afterwards revealed that the dilatation had been considerably reduced and that the passage was less slow (Fig. 3 c). The patient was discharged. A further x-ray examination about 3½ months after operation showed that the gastroenterostomy was still somewhat narrow, but that the passage was satisfactory (Fig. 3 d).

*Case 5.* K. 1040/45. Man aged 56, with duodenal ulcer. Resection with retrocolic gastroenterostomy, in which the intestine was inserted terminolaterally into the major part of the gastric cross section. The patient felt well for a week, was up, drank freely and the bowels were moving, when he began to feel rather sick and 13 days after the operation he vomited. On the following day 200 ml of the gastric contents, consisting partly of food remnants, were aspirated with a tube, but on the next day only 50 ml. X-ray examination showed a very marked swelling of the mucosa on the stomachal side of the gastroenterostomy. The afferent loop was filled, but not the efferent (Fig. 4 a). On the following days signs of total obstruction (the patient was using an indwelling nasal catheter into the stomach), and 22 days after the operation a second laparotomy was contemplated, but then the stomach began to empty and continued normally. X-ray examination 28 days after the operation showed that the evacuation was proceeding at an almost ordinary rate and mainly to the efferent loop (Fig. 4 b); at the control examination 6 months later the patient was feeling well and the roentgen finding was normal. Another interesting feature in this case was the patient's reaction to dicoumarin, administered as a prophylactic against thrombosis. The patient's prothrombin index on the morning of the day of the operation was 88, and the day after the operation he received dicoumarin of 0.25 gm. The index gradually fell and 5 days after operation reached the bottom value 23, but afterwards slowly rose to 60 on the 10th day. Without any additional dicoumarin the index on the following days was 40, 52, 47, 43, 48, 37, 37, 35 and when it fell to the last-mentioned value 18 days after operation, vitamin K was administered intravenously, together with a blood transfusion of 350 ml. The index then rapidly rose to 78, 81, 93 and



Fig. 1 a. Case 2.



Fig. 1 b. Case 2.



Fig. 1 c. Case 2.



Fig. 1 d. Case 2.

IVAR R. SANDBERG: Postoperative Emptying Difficulties.

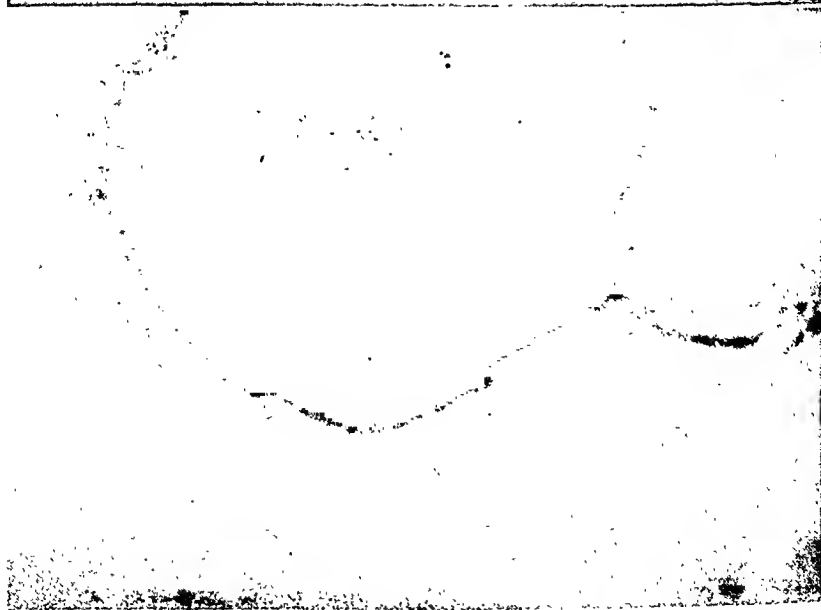


Fig. 2 a. Case 3.



Fig. 2 b. Case 3.



Fig. 3 a. Case 4.



Fig. 3 b. Case 4.



Fig. 3 c. Case 4.



Fig. 3 d. Case 4.

IVAR R. SANDBERG: Postoperative Emptying Difficulties.





Fig. 4 a. Case 5.



Fig. 4 b. Case 5.

finally to 98; the stomach already began to empty at 81, and on the following day the passage was clear. The fluid and salt balance as well as the plasma proteins were kept normal throughout after the operation.

According to our experiences from Karolinska sjukhuset, the immediate postoperative emptying difficulties following gastric resection are in many cases due to edema and infiltration into the gastroenterostomy opening or the slit in the mesocolon. The mechanical or dynamic emptying difficulty thus caused, however, is usually of a transient nature. The treatment should therefore primarily consist of a permanent drainage of the stomach with a duodenal tube, which, especially in case of an atonic stomach, may have to be connected to a suction apparatus. Disturbances in the fluid and salt balance and in the plasma proteins are usually secondary to the emptying difficulties but should, of course, be carefully observed and properly treated. The supply of fluid by mouth should at first be moderate and very gradually increased. As a considerable gastric retention may exist without the occurrence of nausea and vomiting, a stomach tube should be inserted on the least suspicion of retention. — Prostigmine in repeated doses should always be used. — The dicoumarin treatment as a prophylactic against thrombosis in these cases should proceed cautiously, as these patients, in our experience, seem to be sensitive to dicoumarin, and even small doses may entail unexpectedly low index figures, which in turn may perhaps conduce to the occurrence of gastric atony.

Though x-ray examination throws considerable light on the emptying of the stomach, one should not be induced by the roentgen finding to perform a premature relaparatomy, as seems to have occurred in some of our cases. If such a treatment is considered to be indicated, one should merely form a jejunostomy for feeding purposes, unless there is a real mechanical obstruction. The establishment of a second gastroenterostomy should, if possible, be avoided as these operations are often ineffective or unnecessary and the mortality is very high.

### Summary.

Report on five of the cases of postoperative emptying difficulties, in direct connection with gastric resection (illustrated by fine x-ray pictures), which occurred at the Surgical Department

of Karolinska sjukhuset in the course of the years 1940—45. The principles for the treatment of these evacuation disturbances are discussed.

### **Zusammenfassung.**

Bericht über 5 von den in der Chirurgischen Klinik des Karolinschen Krankenhauses in den Jahren 1940—45 vorgekommenen Fällen von postoperativen Entleerungsschwierigkeiten im direkten Anschluss an Magenresektion (durch anschauliche Röntgenaufnahmen illustriert). Es werden die Grundsätze der Behandlung dieser Entleerungsstörungen vorgelegt.

### **Résumé.**

Relation des 5 cas où survinrent des difficultés postopératoires d'évacuation directement après une résection d'estomac, à la Clinique Chirurgicale de l'Hôpital Carolin entre 1940 et 1945 (ils sont illustrés par de belles radiographies). Exposé des principes du traitement de ces troubles de l'évacuation.

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## A Case of Aseptic Necrosis of the Patella.

By

MALTE BRUNK.

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Several cases of what has been considered to be aseptic necrosis of the patella in children have already been described in the literature, while only a small number of corresponding changes have been observed in adults. As I have had the opportunity of following a case of aseptic necrosis of the patella for several years, a report on this case might be of a certain interest, although the ultimate link in the chain of proof, the patho-anatomical examination, is missing. As far as I know, no such case with the same localisation has as yet been published.

The cases of so-called aseptic necrosis of the patella in children, referred to above, have been diagnosed roentgenologically, and they can be divided into two groups according to the appearance of the roentgenograms.

One type has been described by SVEN JOHANSSON and SINDING LARSEN (1921) and several authors have since then published cases with the same characteristics, *e. g.*, VAN NECK, HAWLEY & GRISWOLD, VAN NES, MAU, and KUH. The affection is said to attack children in the age from 10 to 14 years. The change manifests itself in the form of a fragmentation of the bone structure within the inferior part of patella. The separated fragments have rounded outlines without any suggestion of lines of fracture. The picture is said to correspond to that found in Schlatter's disease, and is thus included in the group of aseptic necrosis of the bone. However, HELLMER showed in his investigation into the

ossification of the patella (1935) that exactly similar pictures are found in certain stages of the development of the patella, and that the finding described as pathological, only represents a stage in the normal development. A diagnosis can thus not be made solely on the basis of the roentgenological finding, and this group of so-called aseptic necrosis can therefore probably be discounted.

The second group of aseptic necrosis of the patella in children is the one where the roentgenological picture corresponds most closely to the picture presented by Köhler's disease of the os naviculare pedis. Several cases have been described (KÖHLER, KORITZINSKY, KREMSER, BLENCKE, GELLMAN's case No. 1). Here, too, HELLMER has shown, in his previously mentioned paper, that the roentgen finding in these diseases corresponds in detail to the picture of normal stages of ossification of the patella, and that the changes described therefore cannot be considered pathological. In three cases, reported by MOFFAT, MAU, and GELLMAN (Case No. 2) there is no doubt a pathological process in the patella. In 1939 S. VON ROSEN made a closer analysis of these cases and arrived at the conclusion that it probably is a question of an osteomyelitic process in the patella and that the roentgenograms thus did not correspond to an aseptic necrosis but instead to an inflammatory process. Weighty objections have thus been raised against all these cases, and it consequently appears to be doubtful whether they have any relation to aseptic necrosis at all.

Cases of aseptic necrosis of the patella have been described *e. g.* by PAUL ROSTOCK. In all his 5 cases the alterations were localised to the lower pole of the patella; in the roentgenograms they appeared as a more or less distinct rarefaction of this portion of the bone. His last case displayed such a rarefaction within the inferior pole of the patella, but also, within this area, a thin needle-shaped dense shadow, *i. e.*, the picture of a sequestrum. Three of his cases were operated on. At the site of the roentgenological change a cavity in the bone was found, which contained degenerated tissue. Bacteriological examination revealed that the content of the cavity was sterile. The result of the histological examination of the surrounding bone in this last case is particularly interesting. The intima as well as the media of the vascular walls were greatly thickened so that the lumen of the vessels had narrowed or even become obliterated. On the basis of this finding ROSTOCK assumes that a vascular disease of unknown origin has brought about a disturbance in the nutrition, entailing an aseptic

necrosis within the area supplied by the vessel in question. MEISELS has described a case with changes of the patella, and denotes the alteration as osteochondritis of a patella bipartita. His diagnosis is based on the roentgenological finding. He found a bilateral patella bipartita; the space between the two parts of the patella showed sharp demarcation lines on the sound side. On the diseased side this line was uneven, dented and frayed, and the smaller part of patella here showed numerous well-defined pin-head-sized rarefactions; similar changes were also present in the adjacent portion of the larger part of the patella. In the course of treatment the patient's subjective troubles — pain in the knee and tenderness over the lateral part of the patella — subsided. No histological examination was performed, nor were any roentgenograms taken after the clinical healing. ROSTOCK reports this case, and counts it to the same group as his own cases. In my opinion the diagnosis: aseptic necrosis, based solely on the roentgen findings summarized above, seems extremely uncertain. — Finally, some cases of osteochondritis dissecans of the patella have been described.

A common trait displayed by these cases of aseptic necrosis of the patella is that the alterations are found only within a small and limited portion of the bone. In the case that I have had the possibility of following, the alterations have extended over the whole patella. It is true that no histological examination has been done as the patient refused to submit to the suggested operation, but the roentgenogram is in my opinion so incontestably definite that the diagnosis aseptic necrosis seems justified even if based on the roentgenogram alone.

The patient is a 41-year-old stone-breaker, who has previously always been healthy. On May 18, 1940, he slipped when getting out of a car, and struck his right knee against a stone. He was immediately brought to the Surgical. Dept. of the hospital in Karlskrona, where a fracture of the right patella was found. Roentgen examination revealed a fracture through the lower part of the right patella with considerable dislocation. The distal fragment appeared to be divided into two portions (Fig. 1). On May 21, 1940, bloody reposition was performed and osteosynthesis with catgut; no cerclage. Roentgen examination after the operation showed that the shape of the patella had on the whole been restored, but that no exact reposition had been attained (Fig. 2). The post-operative course was uneventful. When the knee had been fixed in plaster for about 6 weeks, treatment with physical means began, and the patient soon became ambulant. Mobility in the knee returned fairly rapidly, and the patient was discharged from hospital on June



17, 1940. He was still suffering from pains in the knee, however, and referred these troubles to the region round the patella: the pains set in particularly when straightening out the knee against a resistance. It was not until October 26, 1940 — *i. e.*, 5 months after the accident — that the patient was able to take up his work again. At that time objective examination revealed a distinct atrophy of the muscles in the thigh, but no swelling of the knee. He felt a pain round the patella when it was pressed against the condyle of the femur, and when straightening out the knee against an active resistance. There was no limitation of his capacity of stretching the knee actively, and he could bend it  $45^{\circ}$  past the right angle. Distinct retropatellar crepitations. His strength when stretching was distinctly reduced. The left knee was normal; no crepitations. During the following time the injured knee became rather worse. The patient could walk on flat ground fairly well, if he did so slowly, but he could not walk rapidly or run, as this gave rise to pains round the patella. It was only with difficulty that he could walk up and down the stairs, he could not kneel nor rise from squatting posture. When straining the knee, swelling set in. He continued working as a stone-breaker, but was partly incapacitated. In August 1941 the patient was again admitted to the hospital in Karlskrona. There was now a great exsudate in the knee; condition for the rest unchanged. After some days' stay in bed the swelling disappeared. Roentgen examination revealed that the patella showed a higher degree of calcification than the surrounding bone, and that its lower half was split into several small fragments. The changes within the lower part of the patella extended cranial to the old fracture (Fig. 3). The patient was examined again in March 1943. His subjective troubles remained on the whole unchanged. On palpation the patella appeared to be considerably broader than before; condition for the rest unchanged. Roentgen examination (Fig. 4 and 5) now showed that the patella was abnormally flattened and has increased in breadth. The whole bone was split into a number of fragments, all highly calcified. In a lateral roentgenogram an anterior fragment stood out separated from a mass of fragments forming the posterior portion of the patella. The joint space in the femoro-patellar joint was apparently only slightly reduced. Since the previous examination the lines of the articular surfaces in the knee joint had become markedly sharper, and on comparison with the other knee these signs of arthrosis deformans are considerably more marked in the injured knee. The patient has since then been examined in Jan. 1945 and Febr. 1946. His subjective troubles remain unchanged. Roentgen examination of the right knee shows an increasing flattening and increase in breadth of the patella, which is still divided into several fragments, all highly calcified. The roentgenological signs of arthrosis deformans in this knee have increased considerably since the previous examination in 1943.

The roentgenological changes in the patella, first the retention of calcium, and then the splitting-up of the bone into several fragments, displayed in the present case, are typical of aseptic



Fig. 1.



Fig. 2.

BRUNK: Aseptic Necrosis of the Patella.



Fig. 3.



Fig. 4.



Fig. 5.

necrosis, and I consider myself justified in making this diagnosis solely on the basis of the roentgenograms. The changes in the present case correspond well to those found in Kienböck's disease and they also appear to be quite analogous to those developing in cases of avascular necrosis of the head of the femur after fracture of the neck of the femur.

The origin of these changes must lie in an interruption of the blood supply to the patella, and this explanation is proffered by several investigators as the cause of aseptic necrosis in general. However, it seems to be difficult to explain how the whole nutrition of the patella can have been interrupted, as the patella is supplied with blood from several directions, from above, from the sides, and from below, and as these vessels form an extensive system of anastomoses in front of the patella.

The best treatment of this disease would probably have consisted in extirpation of the patella as early as at the time when the first signs of pathological changes began to appear, in this case on the discovery of the changes one and a half year after the injury. As early as in 1943 the affected knee joint showed signs of arthrosis deformans of higher degree than in the other knee, and this deforming process has progressed since then. An operation was also suggested in 1941, but the patient refused.

### Summary.

After a short survey of the literature on resembling cases a case of aseptic necrosis of the whole patella, developing after a fracture of the patella, is described. The diagnosis is based entirely on roentgenological findings. The case has been followed for 6 years.

### Zusammenfassung.

Nach einer kurzen Zusammenstellung der einschlägigen Literatur beschreibt Verf. einen Fall von nach Patellarfraktur auftretender aseptischer Nekrose der ganzen Kniescheibe. Die Diagnose fusst ganz und gar auf dem röntgenologischen Befunde. Der Fall ist 6 Jahre lang verfolgt worden.

## Résumé.

Après avoir collationné la bibliographie de la question l'auteur décrit un cas de nécrose aseptique de toute la rotule, survenue après une fracture de cet os. Le diagnostic se base entièrement sur l'image radiologique. Le cas a été suivi pendant 6 ans.

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## **Choledochal Denervation in Biliary Dyskinesia.**

**A report of 15 Cases studied by Induced Changes of the Serum Amylase and Bilirubin (A Morphine-Secretin Test).**

By

HENRIK LAGERLÖF.

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In 1940 REICH suggested an operation to relieve the pain of biliary dyskinesia by sectioning nerves in the hepatoduodenal ligament. He reported that in one cholecystectomized patient the operation decreased the pressure in the common bile duct from 125 mm before to 85 mm ten days after the operation. Injection of morphine caused a precipitate rise in pressure to 220 mm. Because this was not maintained for several hours, as in patients with an intact sphincter the author concluded that the 85 mm level represented a residual pressure due to the tone of the duodenum and that excision of the nerve, in this instance, had relieved the spasm of the sphincter. As far as can be seen from available literature the operation has never been used in patients with biliary dyskinesia.

### **Material.**

During the course of 1943 and 1944 some 30 cases of biliary dyskinesia following cholecystectomy and some cases of biliary colic in seemingly normal gallbladders were admitted in our service. Many cases suffered for years from daily or weekly attacks of biliary colics and were actually invalidized. A trial of REICH's operation on those cases seemed justified. As the primary result of the operation was good the indications were later widened

Table 1.  
*The Material.*

Nr.	Journal	Age Sex	Cholecystogram		Cholecyst- ectomy, date	Choledochus denervation, date	Width of choledochus at denerva- tion
			visual- izing	empty- ing			
1	2073/44	♀ 27	+	normal	3.11.42	16. 4.43	Thin.
2	722/45	♀ 28	0	—	7.10.37	29. 7.43	Normal.
3	5552/43	♀ 33	+	slow	9. 4.43.	25.10.43	Normal.
4	1765/43	♀ 35	0	—	15. 6.39	9. 4.43	Normal.
5	474/45	♀ 36	+	normal	9.12.34	7. 9.43	Normal.
6	5427/44	♀ 38	0	—	29. 6.43	18. 7.	Normal.
7	5409/43	♀ 41			2.42	23. 9.43	Thin.
8	5885/44	♀ 41	+	normal	16. 3.43	2. 6.43	Slight dilated.
9	5354/44	♀ 45	+	normal	9. 6.43	6. 8.43	Thin.
10	3655/43	♀ 49	+	normal	4. 3.35	17. 6.43	Normal.
11	2969/43	♀ 54	+	very slow	8. 2.37	18. 7.43	Normal.
12	3005/43	♀ 54	+	normal	26	4. 6.43	Slight dilated.
13	2280/45	♂ 38	0	—	39	20. 3.44	Very thin.
14	4750/43	♂ 58			17. 7.39	14. 8.43	Normal.
15	842/45	♀ 28	+	normal	no	27. 8.43	Normal.

and some patients with less severe and more recent symptoms were operated.

The material is compiled in table 1, which shows the age and sex of the patients, the function of the gallbladder before cholecystectomy, the date of the cholecystectomy, the date of the choledochal denervation and the state of the choledochus at this operation. The time elapsed between cholecystectomy and new biliary symptoms is seen in table 2.

14 of the 15 patients had been cholecystectomized. In 13 cases reports of cholecystograms before the operation were available. In 9 cases the gallbladder was visualized and in 8 of those it contained stones. Cholecystogram of the findings at operation indicated that in 5 cases the gallbladder was functionally sequestered before the cholecystectomy.

The diagnosis biliary dyskinesia in all cases except one, case 13, was based on the similarity between spontaneously occurring biliary colics and pain attacks produced by morphine and in most cases additional negative X-ray findings of the stomach, duodenum, colon and often also the kidneys. In no case the spontaneous attacks were accompanied by chills or changes of the colour of the skin or the urine.

In one case, 12, there was a slight, continuous icterus. This pa-

tient some months before had been markedly jaundiced and was then interpreted as a case of acute hepatitis. In this case pains could not be produced by morphine and the diagnose is doubtful. The operation was done mainly to exclude stone in the common bile duct.

The location and radiation of the pains and other symptoms will be reported in another paper on the whole material of biliary dyskinesia.

### Method of Elucidating the Function of Oddi's Sphincter Prior to and after the Operation.

The method of elucidating the function of Oddi's sphincter is based upon pain and elevations of serum amylase and bilirubine following upon the simultaneous injection of morphine and secretin. These phenomena are supposed to be produced by spasm of Oddi's sphincter, which causes stasis in the bile- and pancreatic ducts (6, 7).

The experiments were done on a fasting stomach. The patients were asked about spontaneous pains and examined for tenderness, hyperesthesia and hyperalgesia. 10 mg of morphine hydrochloride were then administrated subcutaneously and immediately afterwards 80 clinical units of secretin (Pancrotest, Astra) were given intravenously. Serum samples were taken immediately before and four hours after the morphine injection. The concentration of serum amylase was determined according to NØRBY with a slight modification, giving about 16 per cent lower values than the original (6). The icteric index was determined according to MEULENGRACHT and the serum bilirubin according to JENDRASSIC-GROF (7). Occurring pain, hyperesthesia and hyperalgesia were noted as well as nausea, vomiting and respiratory distress.

### Operation.

8 cases were operated on by Dr. PERMAN and 6 by Dr. ELVIN. Anatomical studies (PERMAN) have shown, that a rather thick nerve trunk originating from the coelic plexus passes behind the portal vein, reaches the neighbourhood of the common bile duct at the level of the neck of the gall bladder and then descends dorsally and medially from the duct to the duodenum. On the



Table 2.  
Result of Choledochal Denervation.

Case nr	Cholecyst- ectomy, date	Spontaneous pains after cholecystectomy	Chole- dochal denerva- tion, date	Spontaneous pains after choledochal denervation	Morphine se- cretin, test, date	Serum amylase differ. 4—0 hours	S e r u m		Pain at test
							Icteric index d:o	Bili- rubine d:o	
1	3.11.42	4 months no, then increasing	16. 4.43	1 month no, then increasing	12. 1.43 <sup>1</sup> 16. 5.43 <sup>1</sup> 30. 8.43 4. 2.44 22. 7.43 15. 4.44 4. 4.44 <sup>2</sup> 4. 5.44 16. 8.44 2. 2.45	51 12 7 37 —2 11 9 31 80	3,5		+ + + + 0 + (+)
2	7.10.37	Since the opera- tion	29. 7.43	2 months no, then increasing. After 6 months as be- fore op. After fever therapy 6 months no, then irregular			1	—0.03	+ +<

8	16. 3.43	Since the operation	2. 6.43	5½ months no, then as before op.	24. 5.43 2. 7.43 9. 3.44	45 —7 16	0 3.5 1	1.33	++ 0 ++ ++
9	9.6.43	Since 1 week after operation	6. 8.43	The first 2 weeks, no, then increasing. After 1 year about the same as before denervation	4. 8.43 9. 9.43 24.11.43	90 23 31	0 0 1		(+) ++
10	1935	Since the operation	17. 6.43	The first 4 weeks no attacks of dyskinesia. Complication with cancer ventriculi.	10. 6.43	192	4		
11	8. 2.37	Since the operation	29. 6.43	> 5 months no, then slight attacks	8. 4.43 3. 8.43 28. 9.43	82 16 70	0 —1 1		++ 0 +
12	1925	Since some month after op.	26. 5.43	2 years no attacks	18. 5.43 19. 6.43	35 11	0		++ 0
13	1939	Increasing since op.	20. 4.44	> 1 month no	15. 3.44 14. 4.44	—1 +1	1 0	0.20 0.07	0 (+)
14	1939	Since op.	14. 8.43	5 weeks no, then increasing	20. 5.43 7. 8.43 <sup>1</sup> 26. 8.43 <sup>2</sup> 25. 8.43	3 77 —10 324	1 1 2 2		++ ++ 0 (+)
15			27. 8.43	No relief	23. 9.43 17. 2.44 8. 2.45	222 326 486	2 2 2.5	0.55 0.45	(+) (+) (+) ++

<sup>1</sup> Fat meal 30 min. before morphine.

<sup>2</sup> 6.4.—22.4.44 7 fits of induced fever to 39.5 C. (coli vaccin i v.)

<sup>3</sup> Drainage tube broken and remained.

<sup>4</sup> 1 mg of prostigmine subcutaneously simultaneous with the morphine.

way it supplies choledochus with some branches. This nerve has earlier been observed by LATARJET (1921), who called it "nerf pancréaticocholedochien". At the operation it is found between the portal vein and choledochus. About 2 cm of this nerve and its connections with the distal part of choledochus were removed, in all cases two or more branches. By microscopic examination they were found to consist mainly of unmyelinated fibres. PERMAN already at the first operation pointed out that the choledochus was unusually narrow. Table 1 shows that dilatation of the choledochus was an unusual finding. In two cases, 8 and 10, a marked edema of the lesser omentum was found at operation. In one of these cases the reason may have been a ventricular cancer discovered some weeks later.

In some cases attempts were made after the injection of morphine to follow the resistance of Oddi's sphincter to fluid pressure in the common duct during the operation, according to BUTSCH, Mc GOWAN and WALTERS. It was found, that the mechanical stimulation of the sphincter by the operative manipulations so affected the resistance that no conclusion could be drawn as to the effect of the denervation. In case 11, which was operated in ether-nitrogen-monoxide narcosis and which had not received morphine before the operation, the resistance of the sphincter was measured before the denervation while the abdomen was temporarily closed. It was found to be more than 600 mm of water. Choledochus was explored in all cases. Choledochal drainage was instituted in 8 cases and secondary cholangiography in 7.

### Postoperative Complications.

In two cases acute gastric dilatation supervened, in at least one case probably due to damage to the duodenal nerves. In this case also the upper part of duodenum on X-ray film was found distended with gas. In both cases the condition subsided in about a week. In one case (6) the drainage tube broke on removal, which made a second operation necessary.

### Results.

*Spontaneous Symptoms.* — The immediate effect of the choledochal denervation on the pains was surprisingly good in all cases

except one, case 15. Several patients after some days considered the pains from the wound as insignificant, compared with the daily dull ache and attacks of pain before the operation. After some weeks in most cases there were no abdominal pains. However, in all cases except one, after intervals of some weeks to some months new abdominal pains appeared. As a rule they were less severe but more continuous than those before operation. Their location was also changed, being more caudal, more diffuse and without the typical radiation to the costal margins and the back below the shoulder blade. Often there was a permanent marked hyperesthesia in the area of the right 6th to 10th thoracic segments. Nausea and vomiting occurred in two cases (1 and 2) which had not been present before the operation.

As the time went on the complaints more and more began to resemble those occurring before the operation, and now, when two and a half years have elapsed since the first operation only one patient (case 12) can be said to have been really cured. The results of the operation is summarized in table 2.

*Morphine-secretin test.* — Table 2 shows that the improvement of the patients after the operation and the recurrence of symptoms are reflected in the morphine-secretin test. Immediately after the choledochal denervation there were no or only weak pains at the test. If elevations of serum amylase or bilirubine had occurred before operation they were markedly decreased. If case 6 is eliminated the decrease of the amylase was  $41 \pm 11$  Nerby units  $\times 10,000$  and of the bilirubine  $0.94 \pm 0.33$  mg. per 100 Ml., thus significant for the amylase. As the time went on the pain during the test reappeared and the amylase and bilirubin elevations increased, in some cases to a higher level than before the operation.

## Discussion.

In cholangiograms MIRIZZI has found evidence of a physiologic sphincter at the level of the hepatic duct in man. He suggests disorders of its contraction to be an important factor in the production of pain and biliary stagnation. MÄRTENSSON has found hypertrophy of a corresponding circular muscular bundle in cat after prolonged injections of morphine. Thus it will seem that morphine causes the hepatic sphincter to contract. The denerva-

tion of the choledochus in my cases was not extended so far proximally that it could have interfered with the innervation of the hepatic sphincter. Nevertheless primarily good results both on the spontaneous pains and the pain provoked by morphine were obtained in all cases except one. This indicates that spasm of the hepatic sphincter was of minor significance for the spontaneous and provoked pains, which must have originated at the end of the choledochus *i. e.* in Oddi's sphincter.

GRAY and SHARPE have shown, that inflammatory mechanical lesions of the cystic duct may be the obscure cause of persistent pains after cholecystectomy and that the pains may disappear after removing of the cystic stump. In my material the cystic stump was explored in most cases with negative findings. For that reason pathologic changes in cysticus are not likely to have been the cause of the dyskinesia. If such had been the case the pain must have been caused in an indirect way by increased irritability of Oddi's sphincter.

One case with intact gall bladder is an exception. Here the pain persisted to the same degree as before the operation, though the tendency to spastic contraction of Oddi's sphincter was lowered, as shown by the morphine-secretin test. In this case the pains may have originated in the gall bladder, in the cystic duct or the hepatic duct sphincter.

The relief of pain may have been obtained by interrupting the pain pathways, by decreased tendency to spasm of Oddi's sphincter or both. As the extirpated nerves contained some myelinated fibres the first possibility seems to be one cause of the primarily good result of the operation.

When morphine was administered, the increase of serum amylase after simultaneous injection of secretin was significantly lowered after the denervation. The increase of serum bilirubin was also lowered though not significantly. Though the possibility of some small interference with the pancreatic innervation must be admitted, this strongly indicates less strong contraction of Oddi's sphincter. If this depends on decreased sensitivity to morphine of the denervated smooth musculature with its parasympathetic ganglia or on the interruption of centrifugal motor impulses from the coeliac ganglion or the spinal cord we do not know. As it is known that morphine stimulates the spinal cord, the last possibility is at least very probable.

It is well known, that obstipation and flatulence unfavorably

influence biliary dyskinesia. To explain this fact IVY and GOLDMAN distended the colon and found that the resistance of Oddi's sphincter increased. Thus afferent impulses from colon may stimulate the spinal cord or the coeliac ganglion and produce efferent impulses to Oddi's sphincter, of the same kind as I have assumed morphine to do. This should indicate a physiologic import of the morphine-secretin test and explain the correlation between clinical symptoms of biliary dyskinesia and pain produced by morphine in cholecystectomized patients.

The evidences that choledochal denervation according to REICH decreases the tendency to spasm of Oddi's sphincter are contrary to the observations of JOHNSON & BOYDEN, that sectioning of the gastroduodenal nerve in cats markedly decreases the rate of gall bladder emptying after fat meals. It will seem, therefore, that their conclusion, that the gastroduodenal nerve mainly carries fibres which lowers the resistance of the biliary outlet does not apply to man.

As the beneficial effect of the choledochal denervation as a rule did not last more than some weeks to months it is probable, that the nervous connections were restored. From a practical point of view it means, that the operation is of little value and should only be performed when, on the suspicion of choledocholithiasis or pathologic process in the remnant of the cystic duct, choledochus is explored and no pathologic changes are found.

### Summary.

Choledochal denervation according to REICH relieved pain in 14 of 15 cases of biliary dyskinesia. After simultaneous injections of morphine and secretin the rises of serum amylase and bilirubin were lowered after the operation, which indicates that Oddi's sphincter contracted less strongly. The effect of the operation was transient.

### Zusammenfassung.

Choledochusdenervation nach REICH besserte oder beseitigte den Schmerz bei 14 von 15 Fällen von Dyskinesie der Gallenwege. Nach gleichzeitiger Einspritzung von Morphinum und Sekretin trat nach der Operation eine weniger starke Steigerung der

Serumamylase und des Serumbilirubins auf, was dafür spricht, dass der Sphinkter Oddi geringere Kontraktion aufwies. Die Wirkung der Operation war vorübergehend.

### Résumé.

La suppression de l'innervation du cholédoque à la façon de REICH a soulagé ou supprimé les douleurs dans 14 sur 15 cas de dyskinésie des voies biliaires. Après injection simultanée de morphine et de sécrétine le taux de l'amylase et de la bilirubine sériques s'éleva moins haut après l'opération, ce qui fait penser que le sphincter d'Oddi se contractait moins fort. L'effet de l'intervention fut transitoire.

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## Cicatrizing Intestinal Tuberculosis and Allied Conditions.

By

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Questions concerning the pathogenesis, etiology, and treatment of the so-called regional ileitis, or regional colitis, and the relation of those diseases to hyperplastic intestinal tuberculosis arouse great interest at present. But at least in the pre-war years no researches on verified, stenosing intestinal tuberculosis have been published which have included the possibility of allied conditions. Material published when other inflammatory intestinal lesions were insufficiently known, may include non-tuberculous cases, and so give a wrong idea of the pathology, character, and prognosis of this form of tuberculosis. I have therefore reconsidered part of some material with tuberculosis and other inflammatory intestinal diseases of surgical importance, examined microscopically by me for the first time already some years ago. I shall give an account of the results.

The different manifestations of tuberculosis in the intestines have been known for a long while. A distinct differentiation of specific and non-specific conditions was, however, difficult. This is often the case even now in hospital work. Earlier medical literature did not show attempts in this direction as is evident from the 19th century theses of this country (HAARTNAN 1847; FLÖDIN 1857) concerning chronic or perforative intestinal inflammations. The existence of both the specific — usually understood as tuberculous — and simple chronic ulcerative conditions in the small bowel and colon was well known. Also the perforation of a catharral ulcer was possible in the opinion then prevailing.

In the literature it is most commonly stated that CORBIN, a French surgeon, first reported a tuberculous intestinal stenosis in 1830. Several stenoses were casually observed by him in an autopsy on a tuberculous patient. The strictures of the intestines, which gradually attached more



attention, were, for a long while, treated together in spite of their different etiology. Intestinal stenoses due to tuberculous, syphilitic or other ulcers, were described. A carcinomatous growth proved a frequent cause at a microscopical examination (COUPLANCE and MORRIS 1878; MACKENZIE 1879). Sometimes the etiology was considered on the whole inflammatory (BARTON 1875) or was entirely overlooked (GAY 1886). According to TREVES (1884) the etiology remains obscure in most cases of inflammatory strictures. It is only possible to state that the causative agent is not typhoidal, dysenteric, or tuberculous. Numerous observations and their publication by surgeons such as CZERNY (1890), BILLROTH (1891), HARTMANN and PILLIET (1891), KÖNIG (1892), CONRATH (1898), WIETING (1905) and others led to the restriction of intestinal stenoses with tuberculous etiology to a well-defined group. The theory of the so-called hyperplastic or tumor-forming, primary, and isolated intestinal tuberculosis then developed, and was generally accepted. It is obvious that the idea of a peculiar position for this form of tuberculosis was still supported by the observations of DARIER (1890) in France and later by many others in Germany, assuming it to have originated from submucous sclerosing without ulcer formation. — The first case — as far as is known — of hyperplastic intestinal tuberculosis in Finland was operated upon in 1898 by KROGIUS and published by him in the following year. The thesis of BARDY (1906) reports 8 cases with a microscopical examination or an autopsy.

The great interest shown by surgeons in intestinal tuberculosis led to the importance of this disease as a causative factor of stenosis being overestimated. Observations of a probably non-specific, stenosing inflammation in the ileum were very seldom reported. The papers of REGLING (1902) as well as of MOSCHKOWITZ and WILENSKY (1923) include a case of non-tuberculous ileal stenosis verified microscopically. An acute or chronic limited inflammation of the colon — usually in or around the caecum — was earlier and is better known. KOCH (1903) pointed out the simple inflammatory nature of the disease in cases of stenosis observed by him in ascending colon. He thought it possible to exclude tuberculosis, syphilis, neoplasms, and also diverticulosis. In France LEJARS (1906) and in England MOYNIHAN (1907) drew attention to a hyperplastic, non-specific inflammation in the colon simulating malignant disease. Also PROUST and LEJARS (1907), MAYO ROBSON (1908), BRAUN (1909) and others have reported similar conditions with the inflammation mostly localized in the caecum. MONSARRAT (1907), ARNSPERGER (1910) and CLAIRMONT (1917) have published single cases of inflammatory tumor of sigmoid flexure caused by simple inflammation or diverticulitis. HAIM (1912) has observed a primary, acute inflammation in the transverse colon. TIETZE's (1920) paper contains a detailed description of the etiology of non-specific inflammatory tumours in different parts of the colon. After him BACH-LECHNER (1921), KÖRTE (1921), MOSCHKOWITZ and WILENSKY (1923 and 1927), MOCK (1931), REICHEL (1933) among others have dealt with regional hyperplastic colitis.

After the well-known paper of CROHN and others from 1932, the

subacute or chronic regional ileitis — also termed enteritis — has been given great attention. In the northern countries STRÖMBECK (1937) has thoroughly studied this disease. Also in regional colitis interest has been re-awakened (HURST and KNOTT 1937 and others). Mostly, however, the literature contains descriptions of single cases.

The relation of tuberculosis to these inflammatory diseases of the intestines — usually held to be non-specific — is still somewhat vague. It is true that SNAPPER (1938) definitely denies the tuberculous etiology of the so-called isolated, hypertrophic, ileocaecal "tuberculosis". HADFIELD (1939), however, states that tuberculosis as a causative factor in regional ileitis cannot be excluded until this has been testified by a great series of cases.

Because of the war it has been impossible for me to observe the literature since 1941.

### Verification.

Between the years 1918—1931 in the Surgical University Clinic II in Helsinki (former Chief: Professor R. FALTIN, M.D.; present Chief: Professor P. E. A. NYLANDER, M.D.) a total of fifteen cases of diagnosed hyperplastic or stenosing intestinal tuberculosis, excluding "primary" anal tuberculosis, were operated upon. Seven of these were resected and eight were short-circuited. In these cases there was no microscopical verification. Therefore I exclude them. Microscopy was possible for me in all the resection cases either from the whole specimen or twice from deposited tissue samples or slides. The histological investigation showed tuberculosis in four cases. In three cases a non-tuberculous inflammation was found. As in one of these microscopy was possible only of small pieces of the specimen and the other parts may have shown tuberculous changes, I exclude this one also.

Consequently, my material consists of four cases of intestinal tuberculosis and two cases of hyperplastic inflammation of the caecum with an uncertain etiology. Besides histologically, the tuberculosis was verified in one case by an autopsy. In the same case tubercle bacilli were found in the sputum.

The fixation of the gross specimens has been done in 10% formalin. Samples were cut for the histological examination from various parts of the specimen. The staining was chiefly done by haematoxylin and eosin and haematoxylin and van Gieson's stain. Dominici's stain for free inflammatory cells, Weigert's stain for elastic fibers, and Gram's bacteria stain were used in some extent.

A number of sections were stained with Ziehl-Neelsen's carbol fuchsin solution for acid-fast bacilli following the directions of HERXHEIMER. The slides were prepared in the Laboratory of the Surgical University Clinics.

The follow-up data are based on information from the parish registers. The past history has been completed in regard to early symptoms from late questions put to patients still alive.

### Clinical Features.

Hyperplastic intestinal tuberculosis is a rare condition. WOOD and WILKINSON (1938) have diagnosed by radiography, sometimes with a microscopical confirmation, this form of the disease 6 times in 88 consecutively examined patients with various forms of abdominal tuberculosis. The ulcerative form is more common. BROWN and SAMPSON (1930) state they have found this localization 148 times in 1801 consecutive routine sanatorium cases. In advanced cases of pulmonary tuberculosis the percentage, as is well known, is considerably higher, reaching 80 in autopsy material (BROWN and SAMPSON and others).

According to the literature (NIKOLJSKI 1903; REICHEL 1933) persons in the thirties and forties have chiefly been attacked. In LOCKHART-MUMMERY's (1934) series on 100 cases the average age was thirty-two, the oldest patient being seventy-eight and the youngest seven years old. The age of my patients was eighteen, twenty-two, thirty-six and forty-one years.

Both sexes were equally represented. The same is true of many foreign statistics (NIKOLJSKI; CONRATH; LOCKHART-MUMMERY). The patients of BARDY, with verified tuberculosis, eight in number, were all women.

The affection is a chronic one. The known duration before operation in my cases was from four months (Case 1) to nine years.

The general condition in all the patients was altered. They all had a slight temperature. A constant symptom was abdominal pain mostly in connection with obstipation. The most constant local sign was a mass varying in size in the right hypochondrium or iliac fossa. Only in one of the patients was the abdomen distended with visible peristalsis.

Opinions differ as to the congruence between the intestinal and pulmonary lesion in hyperplastic tuberculosis. In the view of CONRATH, BARDY, HÜLSE (1914), ERDMAN (1920), LYNCH (1920) and many others, the large number of sclerosis is associated with a mild tuberculosis, inactive as regards pulmonary changes. Very often this was understood to be a special primary form of tuberculosis. Of the 150 cases collected by NIKOLJSKI, tuberculosis elsewhere in the body was found only in 27 %. To LOCKHART-MUMMERY it is obvious that the hyperplastic form in the colon is a primary tuberculous lesion. Only in one-fourth of the cases

was there any evidence of other localisations and even then it seems to the present author almost certain that they have developed secondarily, to that in the colon. Even in some of the autopsies no other manifestations were found. Negative autopsy findings are also mentioned by REICHEL.

In my cases pulmonary tuberculosis was diagnosed by physical examination in two cases and in the other one confirmed by bacilli findings. The first patient suffered simultaneously from a cervical and axillar — probably tuberculous — lymph adenitis. In Case 2 only a cervical lymphadenosis was diagnosed as a second localisation. Once the physical examination failed to show any symptoms of tuberculosis. It is well known — and confirmed by surgeons who have been able to watch their patients for a long time — that tuberculosis in certain organs is preceded by a cervical or axillary adenitis. This is true also of two of my cases.

The recognition of the ulcerative form of the condition is not always easy. The importance of detailed radiography is pointed out especially by BROWN and SAMPSON. It is true that only the presence or absence of an ulcerative process can be determined. In cases of positive findings of pulmonary tuberculosis, intestinal tuberculosis can be diagnosed with certainty according to the authors just mentioned. The exact preoperative *diagnosis* of the hyperplastic or stenosing form is not possible. Only a chronic lesion causing obstruction — as regards the stenosing form which usually needs surgical treatment — can be diagnosed with a certain amount of probability. The occurrence of other localisations of tuberculosis adds to the likelihood. The symptom of pain and the sign of tenderness in tuberculosis are not of the same importance as in many non-specific conditions. The differential diagnosis between ileo-caecal tuberculosis and appendicitis may sometimes cause difficulties. One patient of mine was incorrectly appendectomized at the beginning of the hospital treatment. LOCKHART-MUMMERY and also REICHEL point out the great similarity of symptoms and signs in both hyperplastic colon tuberculosis and chronic non-specific tumour caused by colitis or pericolitis. This opinion is obviously due the fact that their series contains cases other than tuberculosis.

### Two Cases of Uncertain Etiology.

Among my cases, diagnosed as tuberculosis, were two in which a detailed examination did not show this disease. My observations

were confirmed by the late HARRY CASTRÉN, Professor of Pathology at the University of Helsinki. He could not find in these cases microscopical signs of neoplasms, syphilis, actinomycosis, Hodgkin's Disease, lymphogranuloma inguinale, or other specific changes. In both cases there was an infiltrative, partly hyperplastic, subacute, or chronic typhlitis.

Case 6 (of the whole material) was a 25-year-old woman, who was taken ill less than two months earlier with pain and vomiting. This was later followed by diarrhea and loss of weight. The other patient (Case 5) was a 43-year-old woman, with a pain history of six years. Earlier an inflammatory tumour in and around the caecum had been partly excised. There was a palpable mass in both, and also tenderness in right iliac fossa. Case 6 had a visible peristalsis. There was no fever. In Case 6 occult blood in faeces was determined. In the second case both the benzidine and guaiac tests were negative.

A barium meal and a barium enema showed a stenotic tumour formation. In Case 5 pulmonary radiography showed a small adhesion of the sinus. There were no active changes. The patient did not react to 0.2 and 1 mgr of alt-tuberculin, but 5 mgr caused a rise of the temperature.

### Morbid Anatomy.

The *tuberculous* lesion was once in ileum, and twice either in distal ileum or in a wider area of the small intestine, and also in caecum, and once in caecum only. The thickening in separate caecal or in ileo-caecal tuberculosis is most extensively localised to the region of the valve, which is often narrow. A "tumour" is more or less clearly.<sup>1</sup> In longitudinal sections of the specimen the wall of caecum could be white and fibrous (fig. 1). To the mass attached a thickened mesocolon and an infiltrated retrocaecal adipose tissue together with enlarged lymphatic glands. The mucous membrane of the caecum was usually nodose and affixed to the base. Greater ulcers in caecum or colon were not found. Through the translucent serosa nodules — conglomerate tubercles — some mm in diameter were often clearly visible.

The ileal stricture had on its outer surface a circular groove

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<sup>1</sup> Less frequently ileo-caecum or colon has narrowed to a rigid tube as the result of a uniform sclerosis. LOCKHART-MUMMERY in this connection speaks of a gas-pipe colon. I have operated on such a case.

with a rugged serosa. It was also characteristic that the adipose tissue of the mesenterium covered more of the surface of the intestine than usual. These changes corresponded on the side of mucous coat with a cicatricial, diaphragmatic formation (fig. 2).



Fig. 1. Case 4. Ileo-caecal tuberculosis.

In one case of ileo-caecal tuberculosis several open or healed ulcers (fig. 1) were found in terminal ileum. They were irregular in shape, usually about 1—2 cm in size. Their greatest length corresponded with the longitudinal axis of the intestine. — The histological examination of my cases showed that the changes due to the tuberculous toxins in the intestines varied greatly. The epithelium was often left over a wide area and the haemorrhage in the lumen in con-

sequence was usually slight. In more prominent areas especially when they covered subepithelial tubercles, a severe desquamation and loosening of the epithelium due to an oedema could be seen. In the cells vacuolation, changes in the size and outline of the nucleus, and karyorrhexis was visible, and they were stained badly. In substantia propria the number of eosinophile leucocytes seemed greater.



Fig. 2. Case 3. Ileal diaphragmatic stricture.

The parts favoured by the incipient tuberculosis — in advanced cases of reinfection — in ileum were, as far as I could find out, the pouches between valvulae conniventes (plicae circulares; fig. 3). There a limited *diffuse infiltration* often appeared formed by free inflammatory cells and by polymorphonuclear leucocytes (fig. 7). The proliferative changes of the mesenchyme cells were in the background. Typical giant-cells were, however, often seen. Other cells to be mentioned are the transition forms between fibroblasts and epithelioid cells. The morphology of these is described in detail by CASTRÉN (1923) and others.

To these diffuse, although clearly progressive changes the granulation tissue formation (fig. 4) belongs consisting superficially of a great number of polymorphonuclear leucocytes. It is often difficult to verify the tuberculous nature of these changes, but the

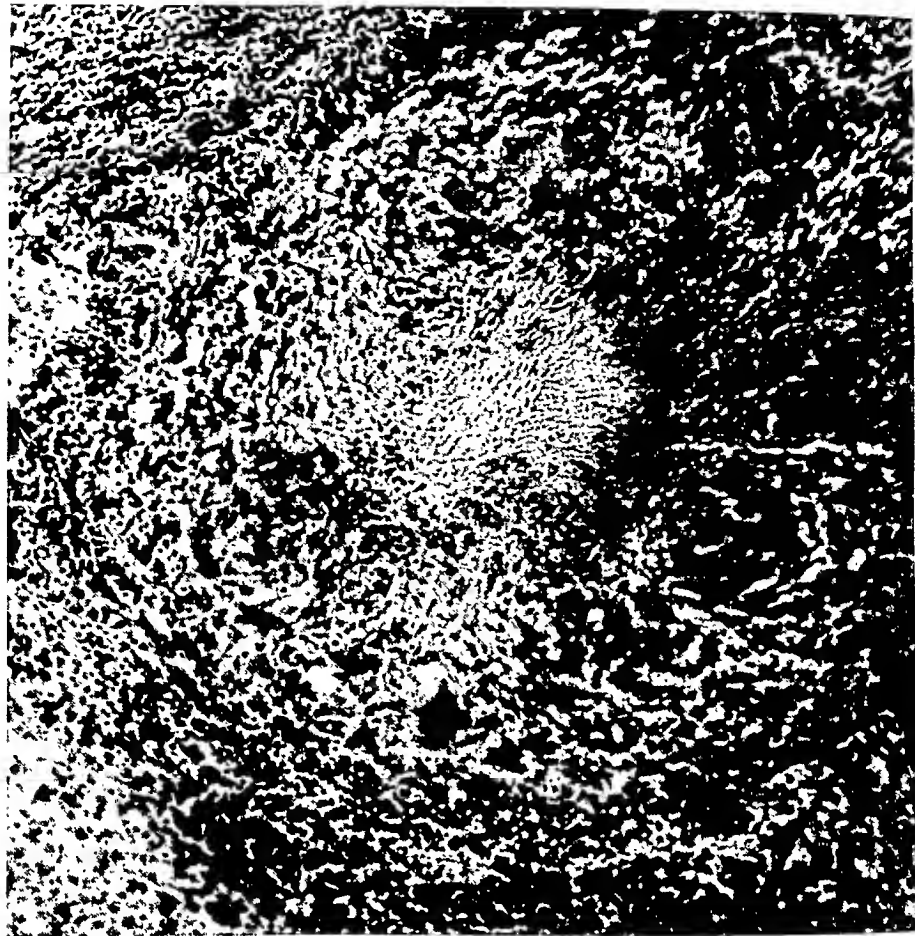


Fig. 5. Case 4. Central necrosis of a solitary tubercle.  $\times 100$ .



Fig. 6. Typical Langhans's giant-cell from a case (2) of combined tuberculosis.  $\times 450$ .



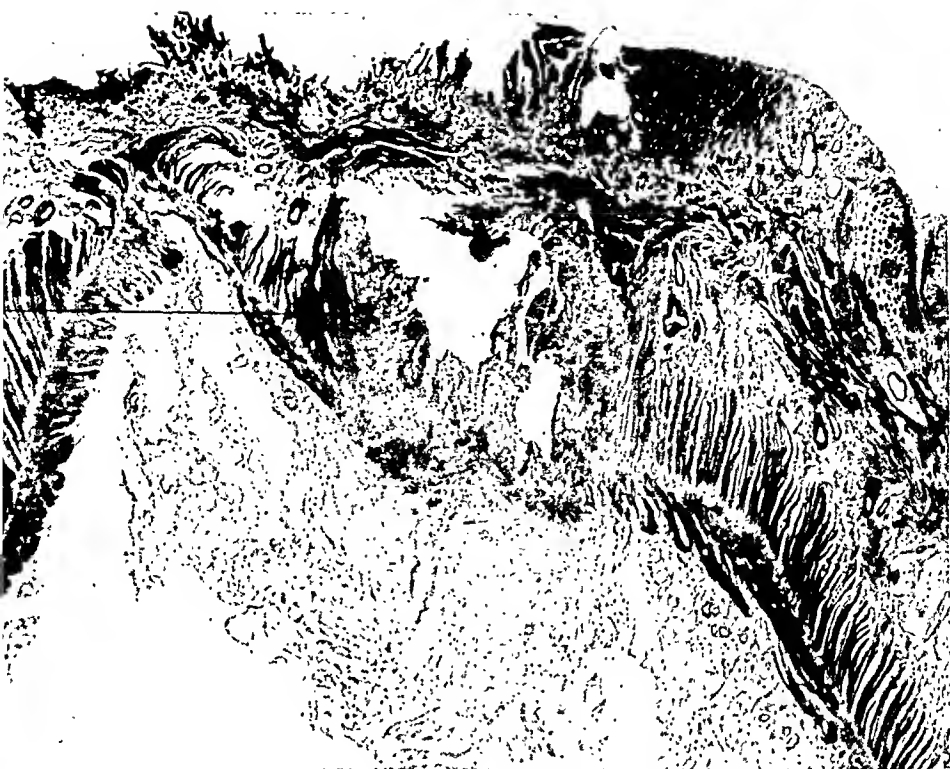


Fig. 9. Case 3. Microscopical view of diaphragmatic ileal stricture.  $\times 9$ .



Fig. 10. Point (a) from the previous figure. Degenerated crypts.  $\times 100$ .



Fig. 11. Case (5) of typhlitis.

INBERG: Cicatrizing Intestinal Tuberculosis.

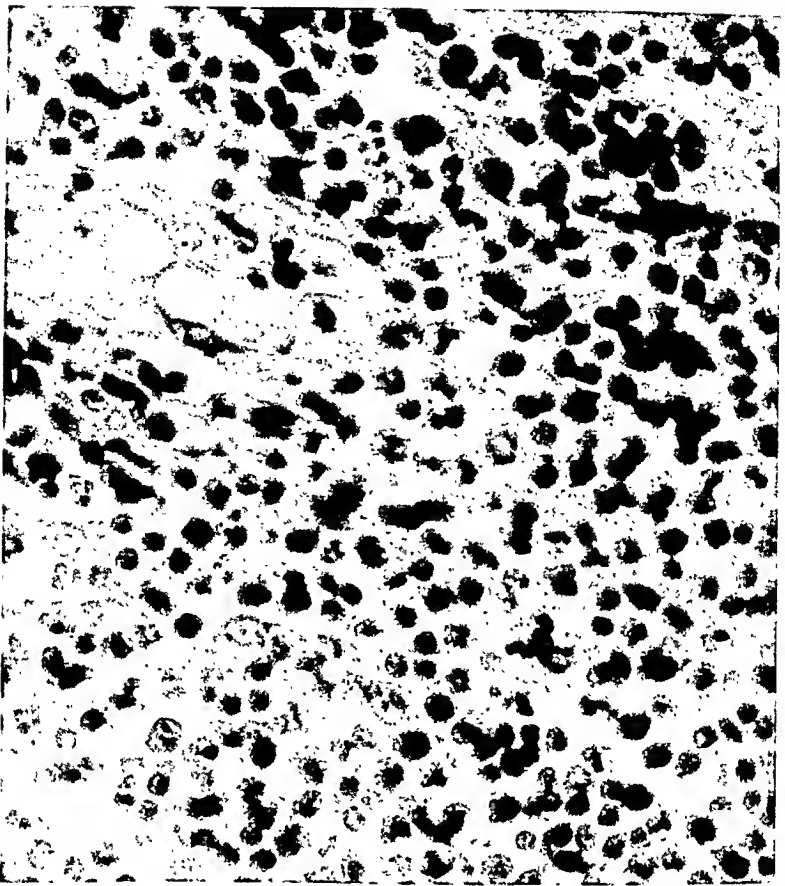
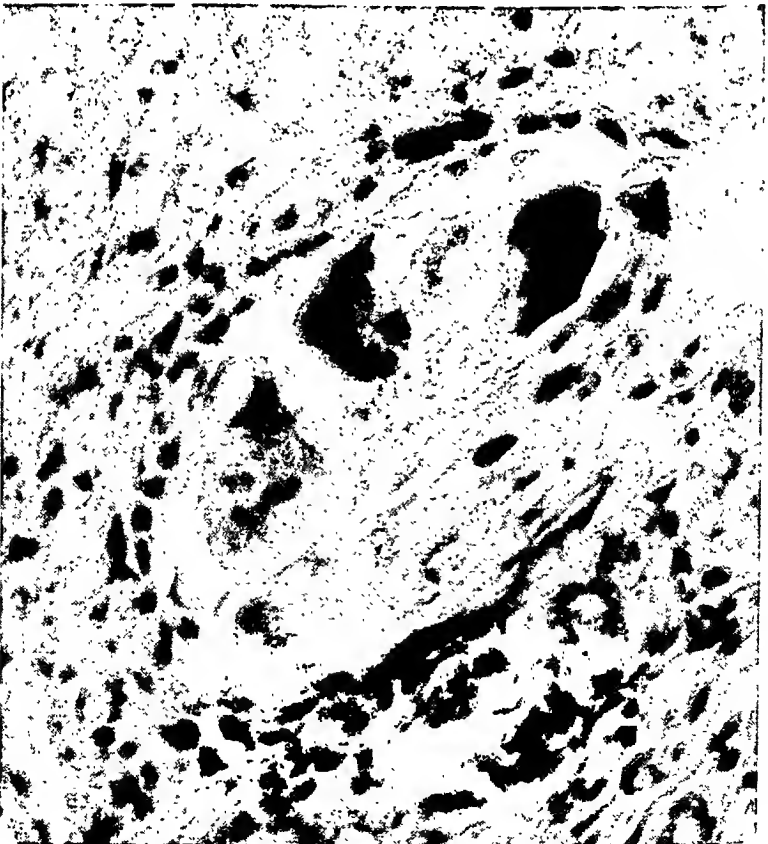


Fig. 12. Case 6. Round cell infiltration.  $\times 450$ .



occurrence of giant-cells of Langhans's type makes the diagnosis probable.

Small, probably recent tuberculous *nodules* — epithelioid-giant-cell tubercle — were often seen in the follicles. SIEGMUND (1929) also states that the development of tubercles is at first mostly restricted to the Solitary Follicles or Peyer's Patches. The proliferation of the active mesenchyme cells leads to a loss of lymphatic tissue. A constant retrogressive change was also the fewness and the bad staining quality of cells in the centre of the nodule as a sign of necrosis (fig. 5). Around and inside the tubercles in the area deficient in cells and blood-vessels, the connective tissue was often quite abundant (cf. fig. 5). A central necrosis and an increase in the connective tissue appeared in all cases of tuberculosis. The giant-cells were of Langhans's type (fig. 6) usually 20—100  $\mu$  in diameter. A clear structureless coagulation necrosis — caseation — however, was observed only in one lymphatic gland. In the area of the lesion the submucous coat was considerably thickened as a result of hyperaemia, oedema, tubercle formation, infiltration with chronic inflammatory cells, and increased connective tissue formation. In Case 3, with a history of 9 years, this tissue formed thick bands.

In Case 4, with a known duration of 6 months, tubercles were also seen between the muscle layers and abundantly on the outside of them. The infiltrated adipose tissue was as thick as the submucosa. In the back wall of the caecum the thickening reached 3 cm. The inflammatory changes close to the epithelium defect, however, were the greatest. In the muscle layers and in the subserous coat the number of mast cells was increased. In the latter attention was attracted to single macrophages and histiocytes especially around the blood-vessels.

To the tuberculous infiltration was added a loss of the epithelium which leads to the formation of the so-called primary tuberculous ulcer (figures 3 and 7). The increase in the number of tubercles — about 500—800  $\mu$  in diameter — and their radial spread from the ulcer also through superficial subepithelial layers cause additional destruction of the epithelium. Thus larger, so-called secondary tuberculous ulcers (fig. 8) are developed through a fusion of several small ones. At the edges conglomerates of tubercles are seen. In caecum the ulceration had resulted in epithelial defects, filled by granulation tissue.

The diaphragmatic formation of the ileal stricture, projecting

into the lumen, was found to be due to adhesion of the near-by serosa surfaces ad modum Lembert's suture (fig. 9). The covering mucous membrane was irregular in shape without the muscularis mucosae. The bands of connective tissue in the submucous coat passed through a break in the muscular coats. In the former there were remnants of the muscularis. Deep in the scar, at the level of the muscular coats, were some degenerate Lieberkühn's crypts (fig. 10). A limited thickening of the subserous and serous coats provided against perforation.

The result of an intestinal stenosis is that the intestine wall thickens and its muscle layers become hypertrophied. The thickness of the latter above the stenosis sometimes reached 2—3 mm or even more but in normal cases only 0.8 mm. In Case 4 the muscle coats were 0.9 mm, consequently barely thickened. The case reports also stated that the indication for operation was abdominal pain and not the symptoms and signs of stenosis. In the edges and sometimes even in the middle of the epithelial defects there were usually remarkable regenerative changes. The regenerated low, cubie, or cylindric epithelium without the muscularis mucosae appeared to originate partly from the epithelium of the Lieberkühn's crypts, partly from the edges of the ulcer. In this epithelium mitotic figures could be seen. The regeneration, too, could begin from the remaining epithelial isles. BROWN and SAMPSON, on the ground of their observations, hold the latter mode to be the most important. According to them also the crypts can regenerate. A deeper ulcer must first be filled with granulation tissue and then with thicker connective tissue.

In about  $1\frac{1}{2}$ —1— $1\frac{1}{2}$  cm lymphatic glands tubercles and an increased connective tissue formation were found. Signs of a peradenitis were small. In the marginal lymph sinus desquamated endothelial cells, lymphocytes and a number of plasma cells were visible. In the small nodes with a diameter of only a few mm a reticulum cell proliferation and hyperaemia were usually to be seen.

In the cases of typhlitis with uncertain etiology, the thickening of the intestine wall was limited (fig. 11) measuring  $1\frac{1}{2}$ —4 cm. The macroscopical changes in the mucous membrane were small. There were some small ulcers and a few larger epithelial defects. Ileum terminale was quite normal. There were round cell infiltration and signs of connective tissue formation in the submucous coat of the caecum. In the subacute case there were besides plasma

cells and lymphocytes, a considerable amount of polymorpho-nuclear leucocytes (fig. 12). In Case 5 the chronic inflammatory cell infiltration and other changes were as large in submucosa as in the loose pericaecal adipose tissue. In both cases here and there in the inflamed area there were circular aggregations of cells with foreign body type giant-cells 8—24  $\mu$  in diameter (fig. 13). There was not the slightest sign of a central necrosis. There was a strong reticulum cell proliferation in 3—10 mm lymphatic nodes.

### Discussion of the Pathogenesis.

The so-called hyperplastic or stenosing intestinal tuberculosis is mostly localized to the ilco-caecal region. In FUCHS's (1926) series of 61 cases the disease was in the ileo-caecum alone, also in other parts 45 times, and elsewhere in the intestines 16 times. A striking fact is the great number of small intestine stenoses — 13 cases. This circumstance, however, can undoubtedly not be considered characteristic for tuberculosis, as the author did not state his criteria as to the specificity of the cases. At least in the opinion of SCHÜPPEL (1921) the small bowel tuberculosis, compared with that in caecum, is quite rare. It is due to the stasis of the intestinal contents in terminal ileum or caecum that the enterogenic infection has its seat in these places. The importance of the mechanical factors in the pathogenesis was well known earlier. The microscopy of my cases also shows, that the process, at least in ileum, begins in those parts which have been longest in contact with the intestinal contents.

Among numerous papers on tuberculous intestinal stenoses SIEGMUND considers that only the investigations of WIETING and BUSSE (1907) are of pathologico-anatomic interest. They have come to contradictory results as to the genesis of these formations. According to WIETING the pathogenesis of the hyperplastic colon tuberculosis and a circular stricture of the small intestine are identical. They originate always from a submucous sclerosing. BUSSE, on the other hand, has observed in one case of the latter form epithelial elements in the scar tissue. This circumstance together with the mode of running of connective tissue bands supports the opinion that the stricture originates from a circular ulcer.

My observations of Case 3 correspond partly with this description and on the other hand are so undeniable that there is very

little doubt about the genesis. Nor does SHIOTA (1908) accept WIETING's opinion in regard to the origin of diaphragmatic ileal stenoses. BUSSE's explanation of the inversion of the outer surface as a result of the destruction of the supporting longitudinal muscle layer may be valid because the ulcer in my Case must have perforated the whole muscle coat.

It is true all the ulcers sometimes, as in Case 1, are so small that their cicatrization cannot cause much stenosing if they do not grow any larger. A lasting, more or less diffuse submucous sclerosis resulting in considerable stenosis, however, seemed to be combined with ulcer formation in all the cases. Although the cicatrizing of intestinal tuberculosis must be understood to be the final stage of the process, an exact histological examination shows — even in one and the same case — a number of regressive and progressive changes side by side. These do not differ from the tissue changes considered in pathologico-anatomical research (SIEGMUND, BROWN and SAMPSON and others) as characteristic for the common — usually called ulcerative — form of intestinal tuberculosis. The only difference is the vast formation of connective tissue. The question is merely one of distinguishing different stages. Characteristic for the caecal form is the hyperplastic infiltration of the loose pericaecal adipose tissue. A similar thickening was seen in non-specific cases of typhlitis. The changes in question may consequently depend more on normal-anatomical qualities than on the specificness and mildness of the infection or the alterations in the state of immunity. My opinion is vindicated also by the fact that not only in the cases now published, but also among other cases I have examined, I have never found signs of a clear hyperplasia in the small intestine.

The theory that the so-called hyperplastic intestinal tuberculosis is a special, low grade form is also disproved by the observations of an active pulmonary tuberculosis in combination with a typical diffuse small intestine ulceration and a hyperplastic caecal tuberculosis in Case 4. There may not be such a congruence between intestinal and pulmonary tuberculosis as stated by BLOMROOS (1938) in connection with laryngeal tuberculosis. A vast, connective tissue formation localized to some areas does not always mean a good prognosis.

Because clear tuberculous changes are lacking in the surroundings of the blood-vessels, the hematogenous origin must be held to be unlikely. This is stated because FLECKSEDER (1927) and

others have laid much stress on this fact. The intestinal primary complex is a very rare condition. For example SIEGMUND, a pathologist, describes only one case observed by him in an autopsy.

The diagnosis must for many reasons — mostly already mentioned in this paper — be held certain, in spite of the negative findings in regard of acid fast bacilli. Sometimes, although very seldom, it was possible for me to detect bacilli of this kind in great giant-cells in other cases of cicatrizing intestinal tuberculosis. The difficulty in finding is obviously due to the fact that for years the specimens have been preserved in formalin. ELLONEN (1942) has shown exactly that the 10% solution of formalin considerably reduces the chance of finding.

My histological and clinical investigations do not disclose facts proving my cases of *typhlitis* to be early or final stages of tuberculosis. As the earlier operation showed that the vermiform appendix was part of the mass in Case 5, appendicitis as an etiological factor deserves attention. In TIETZE's opinion among others some inflammatory intestinal "tumours" are caused by appendicitis. In Case 6 again the vermiform appendix was histologically normal. Such differences in the extent of the changes are quite natural because v. HABERER (1939) for example considers it certain that the chronic, non-specific ileo-typhlitis has not a general etiology. — The probably allergic nature of regional ileitis has been pointed out (BÖRGER 1937; DIXON 1938 and others) in recent years.

Circular aggregations of cells in regional ileitis have been observed by SCHWABACHER (1936), SNAPPER and HADFIELD among others. The last mentioned has described the earliest histological visible lesion as a lymph-adenoid hyperplasia with a formation of giant-cell systems in the submucosa. There was not the slightest evidence of caseation or necrosis. The giant-cells were of Langhans's type. HADFIELD, however, does not seem to be quite sure of the non-specificness of the changes. Earlier MOSCHKOWITZ and WILENSKY, and later SNAPPER speak of foreign body giant-cells in non-specific inflammation of the intestines. KLOSSNER (1944), who, in two cases of pseudotuberculous mastitis, has found giant-cells of myeloplax type (or sometimes of foreign body type), presumes that these cells are of epithelial origin. In both my cases of typhlitis the giant-cells were situated in the connective tissue far away from the epithelium. As they appeared together with epithelioid cells and transition forms, they may be of mesodermal origin.



The question of *nomenclature* still demands a short explanation. As hyperplastic tuberculosis is found only in colon, this term cannot with exactness be used of the small intestine form. On the other hand patients undergo surgical treatment for other reasons than stenosis which therefore cannot be generalised. A common characteristic, however — even in the cases of typhlitis — is intensive cicatrizing.

### Operations and Results.

In three cases of tuberculosis an ileo-caecal resection was made and in one case a resection in ileum about 1 meter. In addition to that one case had been short-circuited in another hospital earlier. The ends were treated after the excision in a different way. Once the ileo-transversostomy was carried out side-to-side. Another time again the ileo-colostomy was done end-to-side. Twice the ends were directly anastomosed.

The results are shown in the table below.

No.	Operation	Result	Tubercle Bacilli in Sputum Autopsy Reports	Follow-up Data
1 (351/21)	20. IV. Ileo-caecal resection. Side-to-side ileo-transversostomy	10. V. Improved	Tubercle bacilli positive. Diffuse small bowel tuberculosis	Died of pulmonary tuberculosis July 1927
2 (978/21)	24. XI. Ileo-caecal resection. End-to-end anastomosis	23. I. Improved		Died of pulmonary tuberculosis September 1923
3 (780/24)	18. IX. Resection of ileum. End-to-end anastomosis	6. X. Improved		
4 (249/27)	16. II. Appendectomy 4. III. Ileo-caecal resection. End-to-side ileo-colostomy	25. III. Died		
5 (235/26)	4. III. Ileo-caecal resection. End-to-end anastomosis	20. III. Improved		In good health in December 1934. No signs of tuberculosis
6 (892/26)	1. X. Ileo-caecal resection. End-to-end anastomosis	12. X. Improved		Reported himself quite well in December 1934. No symptoms of tuberculosis

One of the patients died 3 weeks after the operation with symptoms and signs of activation of the pulmonary tuberculosis. Two patients died 2—6 years afterwards probably of pulmonary tuberculosis. About one patient no informations have been received. After the short-circuiting at an earlier phase the state of the patient had improved, but the recovery was not complete. The mass was still palpable.

Of 100 cases collected by LOCKHART-MUMMERY 93 were operated upon. In 63 cases of resection the mortality was 25%. After short-circuiting (16 cases) the mortality was a little lower, or 18%. The worst results were obtained with an exclusion with colostomy or lateral anastomosis because of 10 cases 8 (80%) died. In verified cases of intestinal tuberculosis the results after operations are bad. BROWN and SAMPSON state that the mortality rate in a small amount of material including some cases of the hyperplastic form, after excision reached 78 %, and after short-circuitings, appendectomies and simple laparotomies was 75%. Much better statistics concerning the operative treatment of the hyperplastic form have been published but without criteria for the specificity of the cases.

According to my personal, though small, experience (2 cases), the danger of the activation of a latent, pulmonary tuberculosis after a resection is great. It is important to pay attention to this fact especially in our country with an increasing number of tuberculosis cases, since the war. The general condition may often be altered for the worse, and the resistance power of the patients reduced. Consideration of a contemporary tuberculous lesion elsewhere in the body has both diagnostic, prognostic, and scientific value. Only from a great number of cases thoroughly examined by specialists and with autopsy reports, can the question of the isolated occurrence of hyperplastic intestinal tuberculosis be finally settled.

An operation should, in my opinion, be performed only in cases with clear radiological signs of stenosis, when no suspicion of a malignant disease makes a laparotomy and biopsy necessary. A two-stage operation should be planned but the first stage should be sufficient if possible. Unnecessary short-circuitings, however, are to be avoided because BROWN and SAMPSON have observed an impairment of the symptoms in advanced cases. The condition of the patient must be watched after the operation, when necessary, with general sanatorial treatment. WOOD and WILKINSON report that a conservative treatment under open-air conditions

was successful in a proportion of hyperplastic cases, if not postponed until intestinal fistulae had formed.

In both the cases of typhlitis an ileo-caecal resection was performed. An after-examination of the one and an after-inquiry of the other after 8 years showed that the patients were still quite well and showed no symptoms of tuberculosis.

The categorical assertion of v. HABERER that a radical resection is the best form of treatment in chronic ileo-typhlitis, cannot be accepted without further consideration. There are contra-indications, among others in young people. HANKE (1940) prefers a two-stage operation in abscess cases connected with regional ileitis. In PEREZ's (1940) opinion even an appendectomy is to be avoided in the mild form of ileitis because of the danger of fistula formation. Also spontaneous recoveries must be taken into consideration. Again in subacute and chronic cases with a palpable mass, tissue changes may often be irreversible and consequently an excision the best form of treatment.

### Differential Diagnosis at Operations.

To distinguish between hyperplastic tuberculosis and neoplasms in the intestines is often difficult. Subserous tubercles are not always visible. Sometimes again pseudo-tubercles, formed by circular aggregations of chronic inflammatory cells with connective tissue formation, cause confusion. The form of intestinal tuberculosis with which surgeons come into contact is mostly characterised by a great amount of sclerosing and shrinking phenomena. A sarcoma or lymphosarcoma in ileum is relatively easily recognized because hyperplasia in tuberculosis does not occur in the small intestine. It is very difficult to distinguish between non-specific intestinal inflammation and tuberculosis. The most important difference is in the intensity of the changes. In non-specific inflammation the cicatrizing process in the mucous membrane is not so far advanced. Large ulcers and diaphragmatic strictures are lacking.

### Summary.

1. In a resection material of intestinal tuberculosis from a period when non-specific inflammation was insufficiently known, a microscopical examination proved tuberculosis only in 4 cases out of 7. The verified material consists of 4 cases of hyperplastic or stenosing tuberculosis and 2 cases of subacute or chronic typhlitis.

2. A diffuse lymphoedema and cell infiltration in the area of the lesion may lead to the thickening of the submucosa, but a lasting sclerosis causing considerable stenosis seems to be combined with ulcer formation. In all the cases there were either small tuberculous ulcers or larger ulcers, epithelial defects or their scars.

3. Hyperplasia did not occur in tuberculosis of ileum. A common characteristic, however, was cicatrizing. That a diaphragmatic ileal stricture with regenerated mucous membrane develops from an ulcer, was shown in one case by the structure of the scar and by finding of epithelial elements in it.

4. My cases do not support the idea that the rare cicatrizing intestinal tuberculosis is isolated. This form of the disease does not depend on a slight infection in the intestine or lungs, because in one of my cases an active pulmonary tuberculosis and diffuse small bowel ulceration was associated with a typical hyperplasia in caecum.

5. The gross pathology of caecal tuberculosis and of the cases of typhlitis was to a great extent identical. The latter was characterized histologically by the absence of specific central necrosis in the circular aggregations of cells and the presence of foreign body type giant-cells.

6. The relatively good results from excisions reported in the earlier literature may be due to the fact that the material consisted of non-specific cases with, on the whole, a favourable prognosis.

### Zusammenfassung.

1. Bei mikroskopischer Untersuchung eines die Darmtuberkulose betreffenden Materials aus einer Zeit, wo die unspezifischen Entzündungen noch unvollkommen bekannt worden, wurde die Tuberkulose nur in 4 Fällen von 7 nachgewiesen. Das Material umfasst 4 Fälle hyperplastischer oder stenosierender Tuberkulose und 2 Fälle subakuter oder kronischer Typhlitis.

2. Das diffuse Ödem und die Zelleninfiltration auf dem Gebiete der Lesion führen wohl zu Verdickung der Submucosa, aber eine dauernde, in höherem Masse Stenosierung verursachende, starke Sklerosierung scheint sich an Geschwürbildung zu schliessen. In allen Fällen wurden kleine Geschwüre oder grössere sekundäre Geschwüre oder deren Narben gefunden. Die sekundäre Geschwüre entsprachen in Cöcum mit Granulationsgewebe gefüllten Epitheldefekte.

3. Hyperplasie scheint nicht in Zusammenhang mit Ileumtuberkulose vorzukommen. Die Struktur der Narbe und das Vorkommen der epithelialen Elemente darin zeigten, dass eine ileale, diaphragmatische, mit regeneriertem Epithel bedeckte Strikture auf dem Grunde der Geschwürbildung entstanden war.

4. Meine Fällen sprechen nicht dafür, dass die seltene, narbenbildende Darmtuberkulose isoliert vorkommen kann. Diese Form der Tuberkulose braucht nicht von Infektion leichteren Grades im Darm oder in der Lunge abhängig zu sein, denn in einem Falle hatte sich an eine aktive Lungentuberkulose mit diffusen ulzerative Dünndarmveränderungen eine typische Hyperplasie in Cöcum geschlossen.

5. Die makroskopische Pathologie in der Cöcumtuberkulose und in den Typhlitisfällen war in hohem Masse einander gleich. Histologisch charakterisierend für die letztgenannte Kondition war das Fehlen spezifischer zentraler Necrose in zirkulären Zellanhäufungen und das Vorkommen Fremdkörperriesenzellen.

6. Die verhältnismässig guten Ergebnisse der Resektion in der früheren Literatur sind vielleicht eine Folge daraus, dass das Material unspezifische, nach der Prognose meisten günstige Fälle umfasst hat.

### Résumé.

1. Dans les matériaux datant d'une période où les inflammations non-spécifiques étaient très peu connues les recherches microscopiques ne constatèrent la tuberculose de l'intestin que dans 4 cas sur 7. Les matériaux comprennent 4 cas de la tuberculose hyperplastique ou engorgeante et deux cas de la typhlite subaiguë ou chronique.

2. L'œdème diffus et l'infiltration des cellules sur l'étendue de la lésion causent certes l'épaississement de la submucosa, mais une forte sclérotation durable qui cause un engorgement semble se joindre à la formation de l'ulcère. Dans tous les cas, des petits ulcères ou des plus grands ulcères secondaires ou leurs cicatrices ont été trouvés. Les ulcères secondaires correspondaient dans le cœcum aux défauts épithéliaux dans la tissue de la granulation.

3. Il me semble qu'il n'y ait pas d'hyperplasie dans la tuberculose de l'iléum. Une caractéristique commune était au contraire la cicatriciation. La structure de la cicatrice et la présence des éléments épithéliaux dans celle-ci ont montré qu'une stricture

iléale diaphragmatique régénérée couverte d'une épithèle s'est formée sur la base de l'ulcère.

4. Mes cas ne parlent pas en faveur de l'occurrence de la rare tuberculose cicatrisante isolée intestinale. Cette forme de la tuberculose ne doit pas dépendre d'une infection plus légère dans l'intestin ou dans les poumons car dans un de mes cas une tuberculose active des poumons et une tuberculose diffuse de l'intestin grêle se sont joints dans une hyperplasie typique dans le cœcum.

5. La pathologie macroscopique dans la tuberculose du cœcum et dans les cas du typhlitis était à près identique. Caractéristique au point de vue histologique pour la condition dernière fut l'absence de la nécrose centrale spécifique dans les aggrégations circulaires des cellules et l'apparition des cellules gigantesques d'origine étrangère.

6. Les résultats relativement bons des résections dans la littérature précédente peuvent provenir du fait que les matériaux ont compris en général les cas non-spécifiques favorables quant à leur pronostique.

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# Über die verschiedene Frequenz der Appendektomien auf Grund unsicherer oder unrichtiger Diagnose akute Appendicitis in den Jahresberichten verschiedener Krankenhäuser.<sup>1</sup>

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Bei der Durchsicht der Jahresberichte schwedischer Krankenhäuser mit ihren Operationsberichten der letzten Jahre findet man nach wie verschiedenen Gesichtspunkten die recht grosse Gruppe akuter Bauchfälle mit einem Verdacht auf oder einer unsicheren Appendicitisdiagnose, bei denen die Operation keinen deutlichen Appendicitisbefund ergeben hatte, beurteilt und in den verschiedenen Krankenhäusern und chirurgischen Kliniken gebucht sind. Die relative Frequenz dieser diagnostisch häufig mehr oder weniger unklaren Fälle erscheint nach den Angaben der Operationsberichte verschiedener Krankenhäuser so wechselnd, dass es von Interesse sein dürfte, die diesbezüglichen Zahlen aus einer grösseren Anzahl unserer Krankenhäuser übersichtlich zusammenzustellen und zwar dabei auch unter Berücksichtigung, unter welchen Diagnosen diejenigen appendektomierten Fälle, die nicht als Appendicitis beurteilt wurden, in den einzelnen Operationsberichten angeführt werden.

Bevor ich auf diese Frage eingehe, will ich jedoch einige Übersichtszahlen aus den Operationsberichten anführen, die eine andere Frage, die mit der Appendicitischirurgie und deren Entwicklung in unserem Lande während der letzten 40 Jahre eng zusammenhängt, veranschaulichen. Es handelt sich um *die*

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<sup>1</sup> In verkürzter Form als Vortrag gehalten bei dem jährlichen Kongress der schwedischen chirurgischen Vereinigung am 23. Nov. 1946.



*relative Anzahl Operationen der Appendicitis im nicht akuten Stadium* — also im freien Intervall, wegen einer Appendicitis à froid oder wegen einer sogenannten chronischen Appendicitis — *im Appendicitismaterial*. Derartige Fälle bildeten früher fast in allen unseren Krankenhäusern einen erheblichen Teil der Blinddarmoperationen. Um diese Frage und die Verschiebung, die in der Beziehung zwischen der Operation wegen einer akuten und einer nicht akuten Appendicitis in jedem Dezennium eingetreten ist, durch zahlenmässige Angaben zu veranschaulichen, habe ich alle in Lund (in der Universitätsbibliothek und der Chirurgischen Klinik) zugänglichen Krankenhausberichte mit Angaben in den entsprechenden Operationsberichten über die Anzahl operierter akuter und nicht akuter Appendicitiden in den Jahren 1902—1903, 1912—1913, 1922—1923, 1933—1934 und 1943—1944 durchgearbeitet; in einigen Operationsberichten, die für diese Untersuchung nicht benutzt werden konnten, sind die akuten und nicht akuten Fälle in weniger glücklicher Weise unter der gleichen Rubrik geführt. In einem grossen Teil aller dieser Jahresberichte, in denen sich Angaben über jede der beiden Gruppen für sich finden, sind die Zahlen so angegeben, dass man *genaue* Auskunft über die Anzahl operierter Fälle erhält. Aus nicht allen erfährt man jedoch die Anzahl operierter *akuter* Fälle, da z. B. manchmal nicht angegeben wird, ob eine Incision eines appendicitischen Abszesses einen eigenen Fall darstellt oder nur ein Sekundäreingriff bei einem in eine andere Gruppe aufgenommenen Fall ist; — es wäre natürlich wünschenswert, dass aus *allen* Operationsberichten deutlich hervorginge, wie viele der Eingriffe unter »XVI« Nachoperationen darstellen. Derartige nicht ganz klare Operationsangaben umfassen jedoch relativ so wenige Fälle, dass, wenn auch die zusammengestellten, unten angeführten Zahlen nicht ganz exakt sein können, sie doch sicher den richtigen sehr nahe kommen.

Die folgende Tabelle 1 zeigt die Summe der in den Jahren 1902—1903 operierten Anzahl Blinddarmfälle aus nur 10 Krankenhäusern: Falun, Gävle, Kristianstad, Lund, Malmö, Sabbatsbergkrankenhaus, Sahlgrensches Krankenhaus, Serafimerlazarett, Sundsvall und Växjö — damals wurden die Jahresberichte nur einiger, besonders der grösseren Krankenhäuser gedruckt, und es wurden bei vielen Operationsberichten aus dieser Zeit, wie z. B. bei denen aus Uppsala, nicht zwischen den akuten und den nicht akuten Blinddarmentzündungen unterschieden. Die Zahlen, die

Tabelle 1.

Jahre	Summe jährlich operierter Fälle			Von den wegen Append. oper. Prozentsatz der wegen:	
	in Anzahl Kranken- häuser	wegen akut. Append.	wegen nicht ak. Append.	akut. Appendicit. operierten	nicht akut. Append. operierten
1902—1903...	10	266	157	63 %	37 %
1912—1913...	40	4,565	1,007	82 %	18 %
1922—1923...	58	8,351	1,183	88 %	12 %
1933—1934...	85	16 067	1,567	91 %	9 %
1943—1944...	71	14,961	1,037	93.5 %	6.5 %

für die Jahre 1912—13 gelten, stellen die Summe von 40 verschiedenen Krankenhausberichten dar, die für die Jahre 1922—23 von 58 Krankenhäusern, die für die Jahre 1933—34 von 85 und die für die Jahre 1943—44 von 71 Krankenhäusern; — dass die Zahl für die letzte 2-Jahresperiode niedriger ist als für die entsprechende aus einem Jahrzehnt früher, beruht darauf, dass die Krankenhausberichte der Stadt Stockholm und mehrerer Amtsbezirke leider in den letzten Jahren nicht im Druck erschienen sind. Jede Zahl der folgenden Tabelle stellt den *jährlichen* Durchschnitt der betreffenden 2-Jahresperiode dar.

Aus der Tabelle geht hervor, dass die *wegen einer nicht akuten Appendicitis ausgeführten Operationen in den letzten 40 Jahren in dem Appendicitismaterial der schwedischen Krankenhäuser von 37 % auf 6.5 % heruntergegangen sind*. Die Ursache hierfür liegt natürlich hauptsächlich darin, dass die akuten Bauchfälle im 20. Jahrhundert an den meisten Stellen unseres Landes in ständig zunehmendem Masse in die zuständigen Krankenhäuser eingeschickt werden und dort, nachdem die Diagnose einer akuten Appendicitis gestellt war, in jedem Jahrzehnt in grösserem Umfange zu einer sofortigen Operation geraten wurde. Hierdurch werden diese Fälle am häufigsten im akuten Stadium operiert. Eine gewisse Rolle hat jedoch ausserdem gespielt, dass die meisten Chirurgen gegenüber der Diagnose einer chronischen Appendicitis allmählich jetzt reservierter geworden sind als vor 30—40 Jahren. In den letzten Jahren betrachtet man es von gewisser Seite sogar als »gewisse Rückständigkeit«, wenn ein Krankenhaus in seinem Operationsbericht eine relativ grosse Anzahl mit einem auffallend hohen Prozentsatz von Appendektomien wegen nicht akuter Blinddarmentzündungen aufweist. Die prozentuellen An-

gaben hierfür sind im übrigen sogar in den Jahren 1943—44 immer noch ziemlich verschieden innerhalb der Berichte der betreffenden 71 Krankenhäuser: einige von diesen haben keinen oder nur einige im nicht akuten Stadium operierte Appendicitisfälle, während diese in anderen Kliniken 12—15 % des Appendicitis-Operationsmaterials ausmachen — in einigen Berichten sogar noch mehr.

*Die wesentliche Frage dieser Untersuchung gilt der Häufigkeit der auf Grund einer unrichtigen oder diskutablen Diagnose, akute Appendicitis, appendektomierten Fälle des Appendicitismaterials der Krankenhäuser in den letzten Jahrzehnten und wie diese Fälle in den Operationsberichten der Krankenhäuser rubriziert und dargestellt werden. Um diese Frage zahlenmässig zu untersuchen, habe ich versucht, die diesbezüglichen Angaben, soweit sie in den oben genannten Krankenhausberichten, also den mir zugänglichen aus den Jahren 1902—1903, 1912—1913, 1922—1923, 1933—1934 und 1943—1944, in einer für diese Untersuchung brauchbaren Form dargestellt sind, zusammenzustellen.*

Aus der früheren Zeit der Appendicitischirurgie: von 1890 bis zu Anfang des 20. Jahrhunderts findet man in unserem Schrifttum und den Krankenhaus-Jahresberichten nicht mehr als nur ausnahmsweise Angaben über einen oder den anderen Fall, bei dem auf Grund einer Fehldiagnose eine unschuldige Appendix exstirpiert wurde. In der Regel handelt es sich dabei um Fälle, die zum Exitus kamen und im Zusammenhang mit den postoperativen Todesfällen angegeben werden, oder um Fälle, deren weiterer Verlauf ergab, dass es sich um eine ganz andere Erkrankung mit diagnostisch irreführenden Symptomen gehandelt hatte. So wird z. B. im Jahre 1907 aus dem Sabbatsberg-Krankenhaus ein Fall mit auch akuten Baucherscheinungen mitgeteilt, der auf eine Appendicitisdiagnose hin operiert wurde, sich später aber als eine tuberkulöse Meningitis erwies. Einige Jahre später tritt im Krankenhaus in Gävle ein Fall auf, bei dem eine Blinddarmexstirpation »auf Grund falscher Diagnose (Pneumonie)« vorgenommen wurde. In den letzten Jahrzehnten ist dieser ganzen Gruppe von Fällen: unschuldig verdächtigten oder unrichtig diagnostizierten akuten Appendicitisfällen, mehr und mehr Aufmerksamkeit gewidmet worden, und es wird von den allermeisten immer mehr die Anschauung vertreten, dass die Anzahl Fälle, bei denen man die Diagnose, evtl. Wahrscheinlichkeitsdiagnose einer akuten Appendicitis stellt und dann bei der Operation einen gesunden

oder wahrscheinlich unschuldigen Blinddarm findet, recht beträchtlich ist. Es ist ganz natürlich, dass die tatsächliche Anzahl dieser Fälle mit der Entwicklung der Appendicitischirurgie zugenommen hat, da die Forderung einer Frühoperation der akuten Appendicitisfälle, die immer mehr gestellt wird, natürlich die Gefahr diagnostischer Irrtümer erhöht hat. Eine weitere wesentlichere Ursache für die Zunahme der Anzahl dieser Fälle in den Jahresberichten dürfte jedoch darin zu suchen sein, dass die meisten Chirurgen, besonders in den letzten 10—15 Jahren eine immer kritischere Haltung gegenüber unsicheren oder geringen Veränderungen des exstirpierten Blinddarmes einnehmen und diese nicht mehr für eine hinreichende Grundlage für die Diagnose einer akuten Appendicitis anerkennen, wie es früher häufig geschah. Ferner sind die meisten Chirurgen im Hinblick auf zunehmende Erfahrungen und Kenntnisse über gewisse akute oder subacute pathologisch-anatomische Veränderungen der Bauchlymphdrüsen, besonders des lymphatischen Gewebes in der Umgebung des Blinddarmes und des Darmes, besonders im untersten Ileumabschnitt mit ihrem zuweilen appendicitisähnlichen Erkrankungsbild, vorsichtiger damit geworden, als Ursache der Bauchsymptome einen Blinddarm ohne deutliche akute Veränderungen anzusehen. Seit jetzt ziemlich vielen Jahren und in den letzten Jahren in den meisten Krankenhäusern, sind in den Operationsberichten diese als Appendicitisfälle diagnostizierten und operierten, diagnostisch unsicheren oder unklaren Fälle in immer grösserem Umfange unter einer besonderen Rubrik: Appendektomie wegen *Suspicio appendicit. acut.* oder *Appendicitis acuta suspecta* geführt worden. In einigen Operationsberichten, besonders aus den letzten 10 Jahren, findet man ausserdem eine grössere oder kleinere Anzahl von Appendektomien unter den Diagnosenrubriken: *Lymphadenitis mesenter. ac. s. ileocecal. ac., enteritis s. colitis ac., typhlitis ac., ileitis terminalis u. a.*, von denen mit grösster Wahrscheinlichkeit die allermeisten — bei denen also die Appendektomie wohl am häufigsten von einem Bauschnitt über dem Blinddarm gemacht wurde — laparotomisiert wurden auf Grund wenigstens einer Wahrscheinlichkeitsdiagnose: *akute Appendicitis*. Ausser diesen eben erwähnten Gruppen von Fällen sind zweifellos in jedem grösseren Material operierter akuter Bauchfälle wenigstens einzelne Fälle vorhanden, die auf Grund der Diagnose oder des Verdachtes einer Appendicitis operiert wurden, bei denen die Laparotomie aber eine sichere

andere Diagnose ergab, ohne dass dieses in dem Operationsbericht angegeben wird. So werden z. B. Fälle, bei denen sich bei der Laparotomie zeigt, dass es sich zweifellos um irgendeine gynäkologische Erkrankung, eine akute Choleeystitis, ein Meekelsches Divertikel, eine deutliche Pneumoeocenperitonitis oder eine andere akute Baucherkrankung handelt, die Gegenstand des Eingriffes wird — völlig unabhängig davon, welche Diagnose vor der Laparotomie gestellt worden war — in der Regel ohne weiteres der Gruppe des Operationsberichtes zugeführt, zu der sie nach dem Operationsbefund gehören. Ein vollständig exaktes Bild über die Zahl der Fälle, die auf Grund einer unrichtigen oder unbestätigten Wahrscheinlichkeitsdiagnose einer akuten Appendicitis operiert wurden, aus den Angaben in den Krankenhausberichten zu gewinnen, ist also nicht möglich. Wenn man jedoch zu der Zahl der Laparotomien, die direkt unter der Rubrik: *Suspicio appendicitidis acutae* angeführt werden, die Zahl der Appendektomien — einfache Probepaparotomien werden nicht berücksichtigt — unter den Diagnosen: *Lymphadenitis acuta mesent.*, *Enterit. ac.*, *Colit. ac.*, *Ileitis terminalis* u. a. hinzuzählt, dürfte man ein Ergebnis erhalten, das wenigstens approximativ — jedoch am ehesten als Minimum — die Anzahl der operierten nach der Anschauung des betreffenden Chirurgen seinerzeit diagnostisch unklaren oder falsch gedeuteten akuten Appendicitisfälle angibt. Die Summe dieser beiden Gruppen ist es, die die Zahlen unter der Rubrik: auf Grund unrichtiger oder diskutabler Diagnose operierter in den Tabellen 2 und 3 angeben. Die in diesen beiden Tabellen angeführten Zahlen stellen den Durchschnitt der jeweiligen 2-Jahresperiode dar.

Und nun zu den *Resultaten der Zusammenstellungen* der Ergebnisse aller Jahresberichte mit brauchbaren Angaben über die oben genannte 2-Jahresperiode jedes der 5 letzten Jahrzehnte.

In den betreffenden Operationsberichten der Jahre 1902 und 1903 findet man keine Angaben über eine Appendektomie auf Grund unrichtiger Diagnose.

Bezüglich der Angaben über die Appendicitisoperationen in den Jahresberichten der Jahre 1912 und 1913 soll zunächst erwähnt werden, dass sich bei manchen Krankenhäusern Angaben über eine gewisse Anzahl von Exstirpationen einer »gesunden Appendix« oder einer »unschuldigen Appendix« finden, die jedoch für diese Untersuchung nicht angewendet werden können, da in sie wahrscheinlich sowohl Appendixexstirpationen »en passant«

als auch solche auf Grund falscher Diagnose einbegriffen sind. In den Rapporten von 9 Krankenhäusern sind jedoch in einem oder beiden dieser Jahre direkte Angaben über die Anzahl der Appen-dektomien auf Grund einer »Fehldiagnose« oder einer »Appendicitis?« gemacht worden. So aus dem Ekmansehen Krankenhaus 1 Fall unter 32 Operationen wegen einer akuten Appendicitis, aus Gävle: 2 von 176 akuten Blinddarmoperationen, Jönköping: 1 und 1 von 120 bzw. 126 Operationen, Mölndal: 1 von 33 Operationen, Nyköping: 4 und 1 von 119 resp. 111 Operationen, Serafimerlazarett: 9 und 6 von 155 bzw. 172 Operationen, Sahlgren-sches Krankenhaus: 6 von 212 Operationen, Sundsvall: 2 von 122 Operationen und Östersund: 1 von 77 Operationen. Summiert man die Zahlen dieser 9 Krankenhäuser — bei 3 davon für beide Jahre, bei 6 davon nur für eines der Jahre — so erhält man: 35 Appendixexstirpationen auf Grund einer Fehldiagnose oder einer »Appendicitis?« unter 1,455 Operationen wegen einer akuten Appendicitis. Nach der damaligen Beurteilung waren also im Jahre 1912 und 1913 in diesen 9 Krankenhäusern 2.3 % der wegen einer akuten Appendicitis vorgenommenen Operationen auf Grund einer Fehldiagnose oder bei Fällen ausgeführt worden, die keine sichere Veränderung des Blinddarmes aufwiesen.

Aus den Jahren 1922 und 1923 sind aus 30 Krankenhäusern für diese Untersuchung brauchbare Angaben vorhanden. In diesen wurden im Jahre 1922 insgesamt 138 unмотivierte oder diskutable Blinddarmexstirpationen unter 4,305 nach der damaligen An-schauung bei der akuten Appendicitis indizierten Operationen gemacht. Die entsprechenden Zahlen für das Jahr 1923 sind 179 und 4,436. Berechnet man den Durchschnitt für diese beiden Jahre, so ergibt sich, dass an den 30 Krankenhäusern 3.5 % der wegen einer akuten Appendicitis vorgenommenen 9,058 Operationen nach dem damaligen Urteil der betreffenden Krankenhausärzte auf Grund einer falschen oder diskutablen Diagnose ausgeführt worden sind.

Eine entsprechende Untersuchung für die Jahre 1932 und 1933 ergibt Folgendes: An 64 Krankenhäusern oder Krankenanstalten sind im Jahre 1932 nach den Berichten 12,470 Patienten, die eine akute Appendicitis hatten, und ausserdem 1,154 falsch gedeutete oder nicht bestätigte Appendicitisfälle operiert worden; die entsprechenden Zahlen für das Jahr 1933 sind: 12,968 und 1,412 — von diesen sind ungefähr 90 % direkt als Operationen wegen Ver-dachtes auf Appendicitis angegeben; ungefähr 10 % der Append-

ektomien bei (meist) Lymphaden. ac. mes. oder anderen Bauchkrankungen. — Der Mittelwert für die auf Grund einer unrichtigen oder nicht festgestellten akuten Appendicitisdiagnose operierten Fälle ergibt sich für die 28.004 Fälle, die an diesen 64 Krankenhäusern in den 2 Jahren als akute Appendicitis operiert wurden, als 9.2 %, also eine weit höhere Prozentzahl als 10 Jahre früher. Diese Zahlen dürften eine erhebliche Verschiebung in der Auffassung der jeweiligen Chirurgen bezüglich der Forderung hinsichtlich der Veränderungen im Blinddarm für eine akute Appendicitisdiagnose von Beginn des Jahres 1920 bis zu Anfang 1930 darstellen.

Num endlich die Angaben in den Krankenhausberichten der Jahre 1943 und 1944. Die unten angeführten Zahlen beziehen sich auf 73 Krankenhäuser oder Krankenanstalten.<sup>1</sup> Die Zahl der Fälle, die in die Operationsberichte als appendektomierte wegen *Suspicio appendicit. ac.* oder unter den Rubriken Lymphaden. ac. mes., Enterit. ac. u. a. aufgenommen wurde, beträgt für das Jahr 1943 für die betreffenden 73 Krankenhäuser 2,547, während 14,611 als operiert wegen akuter Appendicitis registriert werden, für das Jahr 1944 sind die entsprechenden Zahlen 2,605 und 14,850. Auf Grund dieses Ergebnisses ist also die durchschnittliche Prozentzahl unrichtiger oder diskutabler akuter Appendicitisdiagnosen, die in den Jahren 1943 und 1944 an 73 unserer Krankenhäuser operiert wurden, ungefähr 15 %.

Zur besseren Übersicht sind die oben angeführten Zahlen, die das wesentliche Resultat der diesbezüglichen Untersuchung darstellen, in der folgenden Tabelle 2 zusammengestellt.

Aus der Tabelle 2 geht zahlenmässig hervor, d. h. auf Grund von Zahlen, die im Hinblick auf gewisse oben angegebene und andere Fehlerquellen — z. B. sind kleinere Irrtümer in einem oder dem anderen Punkte beim Durcharbeiten aller dieser Jahresberichte nicht ausgeschlossen — zwar keineswegs den Anspruch erheben können, exakt zu sein, jedoch approximativ richtig erscheinen, dass nach den Angaben der Krankenhausberichte *der Prozentsatz operierter unklarer oder falsch gedeuteter Fälle in dem schwedischen Appendicitismaterial in jedem Jahrzehnt der letzten 30 Jahre zugenommen hat: von 2.3 % bis 15 %.* Nach dieser Unter-

<sup>1</sup> Die Zahlen gründen sich zum weitaus grössten Teil auf Angaben im Druck erschienener Krankenhausberichte. Ausserdem habe ich aber von einigen Krankenhäusern, deren Berichte in den letzten Jahren leider nicht gedruckt wurden, durch den dortigen Krankenhausarzt brieflich die notwendigen Zahlenangaben erhalten.

Tabelle 2.

J a h r e	Durchschnitt jährl. operierter Fälle		Durchschnitt jährlich appendektomierter Fälle	
	in Anzahl Krankenhäuser	wegen akut. Append.	auf Grund unrichtiger od. diskutabler ak. Append.-Diagnose	Deren Prozentsatz von allen wegen ak. App. operierten
1902—1903.....	—	—	0	—
1912—1913.....	9 <sup>1</sup>	1,051	24	2.3 %
1922—1923.....	30	4,370	158	3.5 %
1933—1934.....	64	12,719	1,283	9.2 %
1943—1944.....	73	14,730	2,576	15 %

*suchung ist also nach dem Urteil der jeweiligen Krankenhausärzte jede 7. Operation, die jetzt wegen akuten Appendicitis ausgeführt wird, unmotiviert.*

Es ist fernerhin von Interesse zu untersuchen, *wie weit dieser Prozentsatz mit dem Durchschnitt 15 % jetzt, also in den Jahren 1943—1944, innerhalb der verschiedenen Krankenhäuser wechselt.* Die Tabelle 3 gibt den jährlichen Mittelwert der in den Jahren 1943 und 1944 operierten akuten Appendicitisfälle und der operierten unklaren oder falsch gedeuteten akuten Appendicitisfälle samt die Prozentzahl der letzteren für hauptsächlich diejenigen in dieser Untersuchung bearbeiteten Krankenhäuser an, in denen jährlich mindestens 250 akute Appendicitisfälle operiert wurden. Die Krankenhäuser sind in der Tabelle nach der Grösse dieses Prozentsatzes geordnet.

Diese Tabelle 3, in der also jede Zahl den Durchschnitt für die beiden Jahre 1943—44 angibt, enthält Angaben aus 24 Krankenhäusern oder chirurgischen Kliniken mit einem relativ grossen Appendicitismaterial. Wir sehen daraus, dass diese Prozentzahl von 32 % bis auf nur 5 % an den verschiedenen Krankenhäusern und chirurgischen Abteilungen abnimmt. So hielt man in Hälsingborg 32 % aller auf Grund der Diagnose oder Wahrscheinlichkeitsdiagnose einer akuten Appendicitis operierten Fälle — also fast jede dritte akute Appendektomie — nach der Deutung des Operationsbefundes für unmotiviert oder diskutabel, in Jönköping, Lunds Lazarett und dem Karolinischen Krankenhaus mehr als jede vierte, in Östersund, Linköping, Västerås u. a. jede vierte,

<sup>1</sup> Bei 3 der Krankenhäuser Angaben für beide Jahre, bei 6 davon nur für eines der beiden Jahre.



Tabelle 3.

Krankenhaus	Jährlicher Durchschnitt (1943 und 1944)		Deren Prozentsatz von allen wegen akuter Append. operierten
	operierter akut. Append.-Fälle	appendektomierter auf Grund unrichtiger od. unbestätigter Diagnose	
Hälsingborg .....	338	161	32 %
Jönköping .....	275	114	29 %
Lund .....	382	152	28 %
Karol. Sjukhus. ....	142	55	28 %
Östersund .....	416	141	25 %
Linköping .....	373	116	24 %
Västerås .....	255	81	24 %
Vänersborg .....	253	82	24 %
Stocksund .....	226	70	24 %
Örebro .....	398	121	23 %
Uppsala .....	346	90	21 %
Kristianstad .....	288	74	20 %
Lidköping .....	286	69	19 %
Uddevalla .....	362	79	18 %
Skellefteå .....	289	60	17 %
Växjö .....	309	55	16 %
Karlstad .....	274	49	15 %
Sundsvall .....	549	91	14 %
Falköping .....	293	49	14 %
Falun .....	280	45	14 %
Sahlgrenska kir. II .....	371	37	9,1 %
Borås .....	410	40	9,0 %
Mariestad .....	436	29	6,2 %
Sahlgrenska kir. I .....	366	20	5,2 %

in Uppsala, Kristianstad, Lidköping jede fünfte, Skellefteå, Växjö jede sechste, Karlstad, Sundsvall u. a. jede siebente, Borås, Sahlgrensches II ungefähr jede zehnte, Mariestad mit 6.2 % nicht mehr als jede sechzehnte und Sahlgrensches I schliesslich mit nur 5.2 % nur ungefähr jede zwanzigste. *Nach den Angaben von 73 Krankenhäusern ist also im Durchschnitt jede siebente Operation wegen einer akuten Appendicitis unmotiviert oder diskutabel. In den einzelnen Krankenhäusern wechselt aber die Zahl so stark wie von fast jeder dritten bis zu jeder zwanzigsten, bei der also der Operationsbefund nach dem Urteil des jeweiligen Krankenhausarztes keine Stütze dafür bietet, dass die Operation motiviert war.*

Wo soll man nun *die Erklärung für diesen so sehr wechselnden Prozentsatz* in unseren verschiedenen Krankenhäusern suchen? Da die Einstellung, die die überwiegende Anzahl der praktizierenden Ärzte in Schweden jetzt haben dürfte, die ist, so gut wie

alle Fälle, bei denen die Diagnose akute Appendicitis sicher oder wahrscheinlich erscheint, und ausserdem einen grossen Teil, vielleicht den grössten Teil diagnostisch unsicherer Fälle mit akuten Baucherscheinungen sofort ins Krankenhaus zu überweisen, hat offenbar das vorhandene Appendicitismaterial wenigstens der Mehrzahl unserer Lazarette und Krankenhäuser kaum grössere Verschiedenheiten aufzuweisen. Ferner ist zu berücksichtigen, dass zwar erfahrungsgemäss der Prozentsatz falsch gedeuteter und vermuteter Appendicitisfälle grösser unter den weiblichen als den männlichen akuten Bauchfällen ist, dass aber bei dem Material der meisten hier untersuchten Krankenhäuser mit keinem wesentlichen Unterschied in der numerären Verteilung der akuten Bauchfälle auf die beiden Geschlechter gerechnet zu werden braucht. Nicht nur im Sahlgrensehen Krankenhaus mit seiner sehr niedrigen Prozentzahl sondern auch in Hälsingborg, in Lund und dem Karolinischen Krankenhaus mit ihren sehr hohen Prozentzahlen ist nämlich eine eigene Geburtshilflich-gynaekologische Klinik vorhanden. Aus den eben erwähnten hierhergehörenden Verschiedenheiten kann man sicher nichts wesentliches für eine Erklärung des wechselnden Prozentsatzes finden. Ebenso wenig wahrscheinlich erscheint es, dass der grosse Unterschied der Prozentzahlen der einzelnen Krankenhäuser in grösserem Masse durch eine verschiedenen grosse Erfahrung und Fähigkeit der betreffenden Krankenhausärzte, die eingewiesenen akuten Bauchfälle, insbesondere die Appendicitisfälle richtig zu beurteilen und zu diagnostizieren, bedingt ist. Eine gewisse Bedeutung können dagegen die bei unseren Chirurgen bis zu gewissem Grade wechselnden Operationsindikationen haben: Während der eine mehr darauf eingestellt ist, schon auf eine blosse Wahrscheinlichkeitsdiagnose hin sofort zu operieren, ist der andere eher geneigt, bei diagnostisch unsicheren Fällen dieser Art zunächst abzuwarten. Wesentlicher erscheint es jedoch für die Erklärung, dass der eine Chirurg eher geneigt ist — und vielleicht immer noch allzu geneigt — auch Fälle mit weniger deutlichen, diskutableren Veränderungen in dem exstirpierten Blinddarm für eine akute Appendicitis anzusehen, während der andere Chirurg in den letzten Jahren eine kritischere — und vielleicht zuweilen allzu kritische — Haltung einnimmt und nicht gern andere Fälle als solche mit absolut deutlichen sicheren und klaren akuten Veränderungen als akute Appendicitis anerkennt. An den Krankenhäusern, in denen besonders alle diejenigen Blinddärme, die makroskopisch nicht ganz

sicher sind, mikroskopisch untersucht werden, kann ferner auch sowohl die Einstellung des dortigen Pathologen zu der mikroskopischen Appendicitisdiagnostik als auch das grössere oder kleinere Vertrauen des Chirurgen — zuweilen vielleicht allzu grosse Vertrauen — zu dem Resultat der mikroskopischen Untersuchung Bedeutung für die klinische Beurteilung des Falles gewinnen und eine Rolle für den Prozentsatz des betreffenden Chirurgen spielen.

Nun eine weitere Frage, die in der Tabelle 4 veranschaulicht wird: *Unter welcher Rubrik und in welchem Umfang innerhalb der einzelnen Rubriken werden diese diagnostisch diskutablen Fälle in den einzelnen Krankenhausberichten gebucht?*

In ungefähr der Hälfte der in der Tabelle 3 angeführten Berichte der 24 Krankenhäuser sind alle oder so gut wie alle hier zu besprechenden diagnostisch diskutablen Fälle direkt und einheitlich unter der Rubrik *Susp. app. ac.* angeführt. In zahlreichen der Berichte der 14 in dieser Tabelle angeführten Krankenhäuser ist aber, wie es scheint, ein Teil und manchmal ein beträchtlicher Teil dieser Fälle unter anderen Rubriken geführt, und dieses zuweilen sogar innerhalb desselben Krankenhauses nur bei einem der beiden Jahre 1943 und 1944. Wir sehen also, dass ein sehr grosser Teil oder recht viele dieser Appendektomien in einigen Berichten unter der Diagnose *Lymphaden. mes. ac.* gebucht sind: So in Östersund, Sundsvall 1944, Falköping 1943, Vänersborg u. a., in anderen Berichten unter der Diagnose: *Enteritis ac., Colitis ac.* wie in Jönköping 1943 und besonders in Linköping 1943. Aller Wahrscheinlichkeit nach besteht doch diese ganze Patienten-Gruppe trotz der in den einzelnen Krankenhäusern so verschiedenen Rubrizierung eines grossen Teiles der Fälle unter verschiedenen Diagnosen zum allergrössten Teil in dem Material der verschiedenen Krankenhäuser aus ziemlich gleichartigen Fällen.

Sicherlich weichen die Ansichten über die Forderungen im Hinblick auf die Veränderungen des Blinddarmes bei unseren Chirurgen ziemlich stark voneinander ab, wenn es sich darum handelt zu beurteilen, ob die Diagnose akute Appendicitis einwandfrei oder hinreichend begründet ist. Die eben erwähnte sehr verschiedene Einordnung der diagnostisch unklaren diskutablen Fälle in vielen Jahresberichten zeugt ebenfalls von recht stark voneinander abweichenden Auffassungen unserer Chirurgen, oder vielleicht manchmal eher von einer Unsicherheit darüber, welche Erkrankungen und in welchem Ausmasse die verschiedenen

thema bei einem schwedischen — oder im Hinblick auf das, was weiter unten angeführt wird — auf einem nordischen Chirurgenkongress zusammen mit für diese Frage interessierten Pathologen aufzunehmen?

Im Zusammenhang mit dem hier dargelegten Bericht schien es mir auch von Interesse zu sein, sich ein Urteil darüber zu bilden, wie diese unklaren oder fehlerhaft gedeuteten akuten Appendicitisfälle in den Krankenhäusern *unserer nordischen Nachbarländer* beurteilt und rubriziert werden. Ich habe deshalb einige finnische, norwegische und dänische Krankenhausberichte durchgearbeitet und ausserdem brieflich Angaben von skandinavischen Chirurgenfreunden erhalten.

Von *finnischen* Berichten war mir nur eine kleinere Anzahl zugänglich. In diesen findet man nur vereinzelte oder wenige Fälle, die direkt als Probelaaparotomien oder Appendektomien wegen Susp. app. angeführt sind, dagegen aber eine Anzahl von Blinddarmexstirpationen bei Enteritis, Colitis, Coecum mobile, bei Abdominalschmerzen u. a. Die »Appendectomia prophylactica«, die in einigen Berichten mit ziemlich hohen Ziffern angeführt wird, umfasst Appendektomien, die »en passant« bei gynaekologischen oder anderen Laparotomien ausgeführt wurden. Nach brieflichen Angaben sollen die appendektomierten Susp. app.-Fälle in den finnischen Jahresberichten im allgemeinen zu der Gruppe Append. ehr., die auch wenigstens in einigen der Berichte eine relativ hohe Zahl zeigt, gerechnet werden.

In einigen der *norwegischen* Krankenhausberichte seit dem Jahre 1940, die mir zugänglich waren, findet man vereinzelt oder in einigen Fällen direkte Angaben über eine Appendektomie wegen Susp. app. ac. oder wegen Appendicitis?; in vielen der Berichte sind keine derartigen Angaben vorhanden. Dagegen teilt die Mehrzahl der Berichte appendektomierte Fälle unter der Rubrik Colica oder Colica abdominalis mit, in einigen Krankenhäusern eine beträchtliche Anzahl, und ferner unter der Rubrik Lymphadenoma mesent. oder ileocecal., Ileitis terminalis, Enteritis ac., Enterocolit., Typhlit. ac. u. a. in sehr verschiedener Anzahl in den einzelnen Krankenhäusern. Von norwegischen Chirurgen habe ich folgende briefliche Angaben erhalten. Einer von ihnen schreibt: »Frühere Jahresberichte enthalten zweifellos viele Fälle mit der Diagnose: akute Appendicitis, die jetzt als Lymphaden. mes., Enteritis aufgefasst werden müssten, und

auch unklare Fälle mit einer Peritonitis und unbedeutenden Veränderungen am Blinddarm — mangels einer anderen deutlichen Erklärung der Symptome stellte man die Diagnose Appendicitis, obwohl als Operationsindikation hätte angegeben werden müssen Susp. app. In den letzten Jahren ist die Gruppe 'Colica' immer grösser geworden. Dieses beruht wenigstens z. T. darauf, dass die Assistenzärzte in den letzten Jahren die Einstellung vertreten haben, dass ziemlich starke Veränderungen vorhanden sein müssen, sowohl bei der akuten wie bei der chronischen Appendicitis, wenn als Krankheitsursache die Appendix angenommen werden soll; gleichzeitig soll zugegeben werden, dass wir früher in umgekehrter Richtung zu weit gegangen sind.« — Ein anderer Kollege schreibt: »Die unter der Rubrik 'Colica', in den Jahresberichten angegebenen Fälle stellen eine ziemlich bunte Sammlung von Fällen mit Bauchbeschwerden, Kolikschmerzen, zuweilen ziemlich unklarer und schwer zu deutender Art, dar; früher wurden diese Fälle meist als App. ac. oder chr. bezeichnet, auch wenn die Laparotomie zur Exstirpation eines sehr wenig veränderten Blinddarmes geführt hatte. Diese Fälle sind in den letzten Jahren in einigen Berichten unter der Diagnose Colica gebueht.«

In Dänemark ist die Frage über die Schwierigkeiten bei der Appendicitisdiagnostik in der Med. Selskab im Jahre 1929 (am 12. 3., siehe Zusatz zur Hospitalstidende 1929) diskutiert worden. Aus dieser Diskussion soll jetzt, 17 Jahre später, nur ein Ausspruch von CARL WESSEL angeführt werden: »Ich habe ab und zu einen Blinddarm entfernt, der sich als normal erwies«, diese Fälle sind in den Jahresberichten unter der Rubrik »Observation wegen Appendicitis« angeführt; ausserdem ein Ausspruch von HANS WULFF: »während der Jahre 1921—28 waren unter 477 Operationen wegen akuter Appendicitis 79 explorative Appendektomien, die keine sichere Appendicitis sondern eine andere Erkrankung aufwiesen; bei einem Teil der Fälle war es nicht möglich, eine sichere Diagnose zu stellen«; 79 von 556 ist 14 %. — In den dänischen Krankenhausberichten der letzten Jahre findet man sehr verschiedene Angaben über diese Gruppe von Fällen: in einigen Krankenhäusern sind keine Appendektomien auf Grund unrichtiger oder diskutabler Diagnose angegeben, in anderen sind die Zusammenstellungen des Appendicitismateriales so geordnet, dass man nicht beurteilen kann, wie viele auf Grund einer Appendicitisdiagnose mit negativem Appendixbefund appendektomiert wurden, in anderen wiederum wird eine Anzahl von »Appendect.

explorat.<sup>e</sup> mitgeteilt, die bei Adenitis meseraica, Salpingitis, Ileitis, Abdominalis ac., Colica abdominalis, Urolithiasis u. a. ausgeführt wurden, und von anderen erhält man schliesslich genauere Auskunft über die Anzahl von Appendektomien bei »Susp. app.« oder »app. obs.« (in den letzten Jahren häufig bei 15—20 % der unter der Diagnose akute Appendicitis operierten Fälle, wie z. B. in dem Krankenhaus Aarhus und der Chirurgischen Abteilung des Krankenhauses Gentofte). — Auch nach brieflichen Angaben dänischer Chirurgenkollegen ist die Terminologie dieses Gebietes in den Jahresberichten wenig einheitlich und keineswegs klar. In vielen Jahresberichten wird die Mehrzahl der appendektomierten Fälle, die sich nach der Laparotomie als diagnostisch unklar erweisen, unter der wenig befriedigenden Diagnose Colica angeführt. In anderen wird für diese Fälle aus alter Tradition der Ausdruck »Obs. w. Appendicitis« benutzt. In wenigstens einigen dänischen Berichten umfasst die »Appendectomy per occasionem« nicht nur »en passant«-Appendektomien sondern auch Fälle, in denen die Laparotomie auf Grund einer mehr oder weniger sicheren akuten Appendicitisdiagnose gemacht wurde, bei der es sich aber zeigte, dass ein anderes operables Leiden vorhanden war. Einer der Briefe schliesst mit folgenden Worten: »Ich finde, wir haben viel zu viele operierte nicht-Appendicitisfälle; hier ist ein Gebiet, wo die allgemeine diagnostische Geschicklichkeit im Vergleich mit so vielen anderen Gebieten innerhalb der Abdominalchirurgie ziemlich geringe Fortschritte gemacht hat.«

Wie aus dieser kurzen Darstellung hervorgeht, ist es also auch *in unseren nordischen Nachbarländern noch nicht gelungen, in den Krankenhausberichten die Fälle, bei denen eine Appendektomie auf Grund unrichtiger oder diskutabler akuter Appendicitisdiagnose gemacht wurde, in einer geeigneten allgemein anerkannten einheitlichen Form darzustellen.*

### Zusammenfassung.

Eine Zusammenstellung der Angaben in den Operationsberichten der schwedischen Krankenhäuser zeigt, dass der Prozentsatz der auf Grund unrichtiger oder diskutabler Diagnose operierten Fälle des akuten Appendicitismaterials in den letzten 30 Jahren von 2.3 % bis zu 15 % der Fälle zugenommen hat, und ferner, dass dieser Prozentsatz an den einzelnen Krankenhäusern in den letzten Jahren so stark wechselt wie von 32 % bis zu 5 %.

### Summary.

A comparison of information in the reports of operations performed in the Swedish Hospitals shows that the percentage of faulty or disputable diagnosis in the material of patients operated on for acute appendicitis during the past thirty years has increased from 2.3 % to 15 % and further that this percentage figure during recent years is so variable in the different hospitals as from 32 % to 5 %.

### Résumé.

Un examen comparatif des renseignements des rapports des opérations dans les hôpitaux suédois démontre que le pourcentage d'un incorrect ou discutable diagnostic des malades opérés dans les matériaux de l'appendicite, pendant les 30 dernières années, a augmenté de 2.3 % à 15 %, et, de plus, que ce nombre, ces dernières années, est tellement variable dans les hôpitaux différents que de 32 % jusqu'à 5 %.

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Supplement to:

**Caput Necrosis after Traumatic Dislocation of  
the Hip Joint in a 4-year-old Boy, and  
Control Examinations of 8 Cases  
of Luxatio Coxae Traumatica.<sup>1</sup>**

By

SV. QUIST-HANSEN, Oslo.

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In my previous report with the above title the case of caput necrosis had been under observation until the 2nd February 1944, from which date it was, owing to the existing circumstances, no longer possible to have him examined. The report concluded with the remark that the caput necrosis "... in its entire course (presents) the same picture as the spontaneous, aseptic caput necrosis, Calvé-Legg-Perthes, and the final stage must be coxa plana".

As it has now again been possible to have the patient examined,<sup>2</sup> I wish to report the result of the examination made on 25/10 1945.

The boy was still lame, but he could walk more freely and moved the pelvis less than at the examination made on 2/2 1944. The atrophy of the right femur was less pronounced (Circumference of right thigh: 33 cm, of left thigh: 34.5 cm).

From normal initial position he could now hyperextend 5°, while the other movements were of the same extent as before. X-ray examination (Fig. 1) showed slight outward-rotation of the right femur. The epiphysis of the caput was low, broad and flat, but with uniform contours, and was separated from the broad, plump collum by a greatly undulating, but sharply defined epiphyseal line. The height of the cartilage in the joint was con-

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<sup>1</sup> Acta Chir. Scand., Vol. XCII, Fasc. V, p. 393.

<sup>2</sup> By District Physician H. NATVIK, to whom I am greatly indebted.



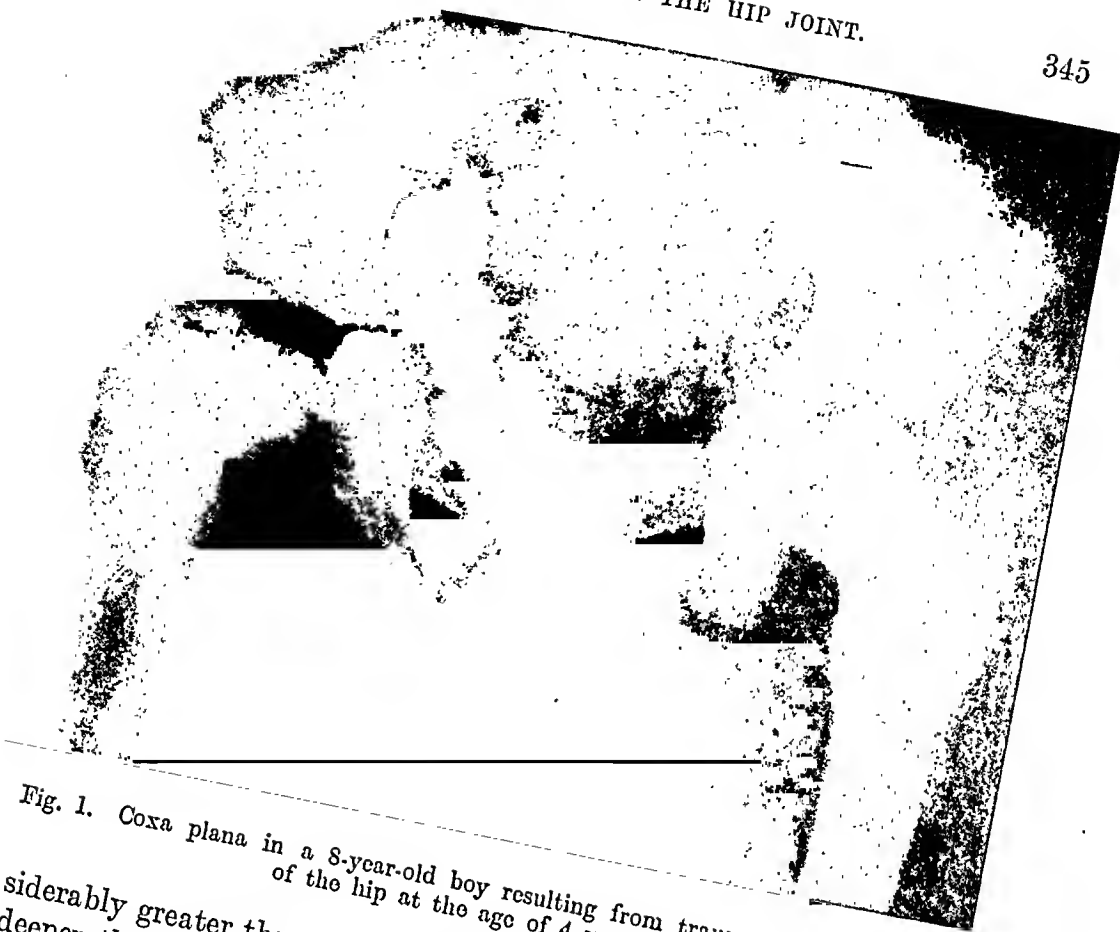


Fig. 1. Coxa plana in a 8-year-old boy resulting from traumatic dislocation of the hip at the age of 4 years.

siderably greater than on the left side. The right acetabulum was deeper than the left, with good adaptation to the shape of the deformed caput.

Four years after the traumatic luxation of the hip joint the boy is now 8 years old and the necrotic caput femoris is reconstructed, with the deformation of the hip joint that is characteristic of coxa plana.

### Summary.

The author has previously published a case of necrosis of the femoral head after traumatic dislocation of the hip in a 4-year old boy where the necrosis presented a picture typical for the course of Mb. Calvé-Legg-Perthes. In the present supplementum a control examination four years after the injury shows the final stage of the traumatic caput necrosis to be a coxa plana as is typical for the Mb. Calvé-Legg-Perthes.

### Zusammenfassung.

Verf. hat früher einen Fall mitgeteilt von Hüftkopfnekrose nach Hüftgelenkverrenkung bei einem vier-jährigen Knaben wo die Kopfnekrose ein für den Verlauf des Mb. Calvé-Legg-Perthes typisches Bild zeigte. Im gegenwärtigen Supplement gibt eine Nachuntersuchung vier Jahre nach dem Unfall als Endstadium dieser traumatischen Kopfnekrose eine Coxa Plana, wie es für den Mb. Calvé-Legg-Perthes typisch ist.

### Résumé.

Dans une précédente publication l'auteur a rapporté un cas de nécrose de la tête fémorale après une luxation traumatique de la hanche chez un garçon de quatre ans, où la nécrose suivit le cours typique de la maladie de Calvé-Legg-Perthes. Dans le supplement présent un examen de contrôle quatre ans après l'accident démontre comme état terminal de cette nécrose traumatique une coxa plana, ainsi qu'on la trouve typique pour la maladie de Calvé-Legg-Perthes.

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## **Avascular Necrosis of the Femoral Head after Central Dislocation Fracture of the Hip Joint and after Isolated Fracture of the Greater Trochanter.<sup>1</sup>**

By

SV. QUIST-HANSEN.

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Numerous deformities of the hip joint after traumatic injuries are now generally known to be due to aseptic necrosis of the femoral head. This aseptic necrosis is an ischemic, avascular necrosis (6, 36, 42, 43, 44, 46) brought about by failure of the blood supply to the head. The head's nutrient sources are the upper and lower capsular artery and the arteries of the round ligament, and in adults also the capillaries coming from the spongiosa of the neck (32, 40, 50 a, 55). The dispute regarding the blood supply through the round ligament seems to be decided by the conclusion that vessels are always present, but with considerable variations in size and number in each separate age group (11, 39, 54). The size and number indicate the importance of the arteries for the normal nourishment of the femoral head. In case of traumatic lesions of the hip joint, however, the extent of collateral circulation between them will decide the fate of the head.

In growing animals the epiphysis forms a barrier between the vessels in the spongiosa of the neck and that of the head which is then dependent on the capsular arteries and the arteries in the round ligament (3 a, 26, 40, 47, 55). In adult animals vessels proceed from the spongiosa of the neck into the head, and the arteries of the round ligament are without importance (55) or supply only a minor part of the head (47).

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<sup>1</sup> Submitted for publication on January 18, 1946.

In man the situation seems to a large extent to be analogous. In young individuals the arteries in the round ligament may be able to supply the whole of the head (46, 50 b), and they may be absolutely necessary for the nourishment of an area about the fovea capitis (11, 17, 27, 29, 43, 44), *i. e.* the same part that in adults has been found vital in otherwise necrotic heads (9, 10, 27, 42, 43 a & b, 46 b, 54). Several cases of traumatic dislocation of the hip joint during growth age show, on the other hand, that even at that age the blood supply to the head may be ensured by the capsular arteries alone, even though they also may have been damaged through the dislocation. Thus the capsular arteries and the arteries of the round ligament sometimes entirely replace each others, and sometimes have completely separate areas to nourish. This has been noted in many cases as regards the upper capsular artery and the arteries in the round ligament, and also necrosis limited to the area supplied by the lower capsular artery has been observed (25).

Caput necrosis after fracture of the femoral neck is rather common (41, 52). After traumatic dislocation of the hip joint the number of cases is considerably smaller (1, 45) and after central dislocation fracture of the hip joint and isolated fracture of the greater trochanter only exceptional cases have been observed (1, 11, 43). A description of the following two cases may be of interest, therefore.

*Case 1.* No. 10309/44. On May 21. 1944, B. P., male, aged 63, jumped from the third floor of a burning house. In the fall he struck against a projecting cornice, sustained concussion of the brain and injury to the right hip. He was caught without difficulty in a rescue-net. On admission X-ray examination (Fig. 1) revealed fractures of the right pubic bone, and fracture of the edge and bottom of the right acetabulum with central dislocation of the femoral head. The femoral neck and the head itself showed nothing abnormal. After skeletal traction for  $2\frac{1}{2}$  weeks the head was well drawn out, but the pelvic fragments were little affected. Five weeks later the traction had to be discontinued on account of serious infection. Redislocation occurred and on August 4. 1944 X-ray (Fig. 2.) showed the position of the head and the pelvic fragments to be as on admission. The density of the neck was reduced, and the head showed a mottled appearance with a small defect on the top. After 14 weeks the patient began to sit up, and from the 18th week he put weight on the limb. He walked with support when in the 20th week he suddenly felt pain in the right hip, and lost active mobility of the joint. Roentgenogram on October 20. 1944 showed advanced disintegration of the head. After confinement to

bed for three weeks and three weeks' exercise he again walked fairly well until, on December 8, 1944, he got the same kind of pain as two months earlier. X-ray examination, however, revealed no further change in the femoral head. The patient was afterwards constantly up and about, and was steadily improving.

At follow-up examination on April 17, 1945 he limped and had to use sticks, but could walk upstairs to his room on the third floor without pain. The point of the right greater trochanter had moved up 3 cm. From an initial position of slight abduction and outward rotation he could attain 60° flexion, 40° abduction, 15° inward and 40° outward rotation. On X-ray examination (Fig. 3.) the femoral head had practically disappeared. The neck, with a remnant of the head, stood deep in the enlarged acetabulum, the borders of which at this point were blurred.

Summary: A man, aged 63, sustained a fracture of the pelvis with central dislocation of the femoral head after injury to the right hip. He was subjected to skeletal traction for 7½ weeks and did not put weight on his limb for 18 weeks. On X-ray examination in the 12th week the femoral head showed a mottled appearance with a small defect on the top, and gradually the disintegration of the head became almost total. After 11 months the hip was severely deformed, but not painful. The patient had a pronounced limp, but walked fairly well with the aid of a stick.

Central dislocation fracture of the hip joint most often arises through direct injury to the greater trochanter (1, 14, 24, 53). The fracture line is fairly uniform, but the degree of central dislocation of the head varies considerably. Sometimes it lies entirely within the pelvic girdle (53). It is reasonable to suppose that the round ligament may be torn, and perhaps also the joint capsule, at any rate where the dislocation of the head is considerable. Yet, it is unusual for central dislocation fracture to be associated with caput necrosis (7, 14, 19, 31). CHANDLER and KREUSCHER observed caput necrosis after central dislocation fracture of the hip joint in a girl, aged 14, and BANKS in a female, aged 63. CHANDLER and KREUSCHER assume the necrosis in their case to be due to disruption of the arteries in the round ligament. In my above case the almost total disintegration of the head presupposes damage to the upper capsular artery as well.

Isolated fracture of the greater trochanter is rare. The fracture is caused by direct injury to the trochanter (10, 24, 33, 43), or it arises as a muscular avulsion fracture (4, 12, 30, 33, 34, 35, 49). There is little or no dislocation, and the fracture heals after immobilisation for 4 to 6 weeks, or without any treatment (33).

Only few cases have been subjected to follow-up examination 6 months or more after the injury. They were all avulsion fractures, and no complications were observed (33, 34). PHEMISTER, however, observed caput necrosis in a girl, aged 12, who sustained an isolated fracture of the greater trochanter in an automobile accident (43), where there most probably existed a direct injury to the hip. The fracture healed normally, but four years later she got pain when walking and restricted mobility of the hip joint. Roentgenogram 6½ years after the accident revealed a partial necrosis of the femoral head which PHEMISTER assumed probably to be due to disruption of the upper capsular artery.

In our department a similar case has been observed.

*Case 2.* No. 5898/41. On April 14. 1941 L. N., a boy aged 15, sustained a violent, but limited injury to the right greater trochanter. On admission two days later X-ray examination demonstrated isolated fracture of the right greater trochanter with slight dislocation (Fig. 4.). The femoral neck and head showed nothing abnormal. After 6 weeks' immobilisation the patient was allowed up. When discharged four days later he limped a little, but two weeks later was free from symptoms even during strenuous bicycle tours.

Eight months after the injury he got pain in the right hip when walking, and limped a little on the right leg. Roentgenogram on January 17. 1942 (Fig. 5) disclosed flattening of the right femoral head with increased density of the summit as compared with the rest of the head. The fracture of the greater trochanter was healed. The patient was confined to bed for two months, and after that had a pronounced limp. His trouble increased gradually and the power flexion in the right hip was reduced. X-ray examination on April 7. 1942 showed increased distance between the femoral head and the bottom of the acetabulum, but otherwise no change since January 17. 1942. On May 23. 1942 a shelf operation was performed (ØWRE). After four weeks' immobilisation the patient was allowed up, and on discharge on July 18. 1942 he walked well, limped less and had less pain than before.

Later on, however, the pain increased and he could hardly walk. On February 1. 1943 X-ray examination showed advanced collapse of the femoral head, and from the foveal region a band of decreased density ran through the head, separating the compressed area from the rest of the head. The head was subluxated and had caused deformation of the acetabulum, but there was no loss of cartilage space. After recumbency for three months his difficulty in walking was greater than ever, and he had to remain at rest. On roentgenogram June 19. 1943 (Fig. 7 a & b) the previously densely calcified part of the head was resorbed, and there remained a bowl-shaped defect lined with partly sclerotic bone tissue. In Lauenstein's position the defect was localised to the central area of the circumference of the head. There was new bone formation at the margin of the head, especially where it rested

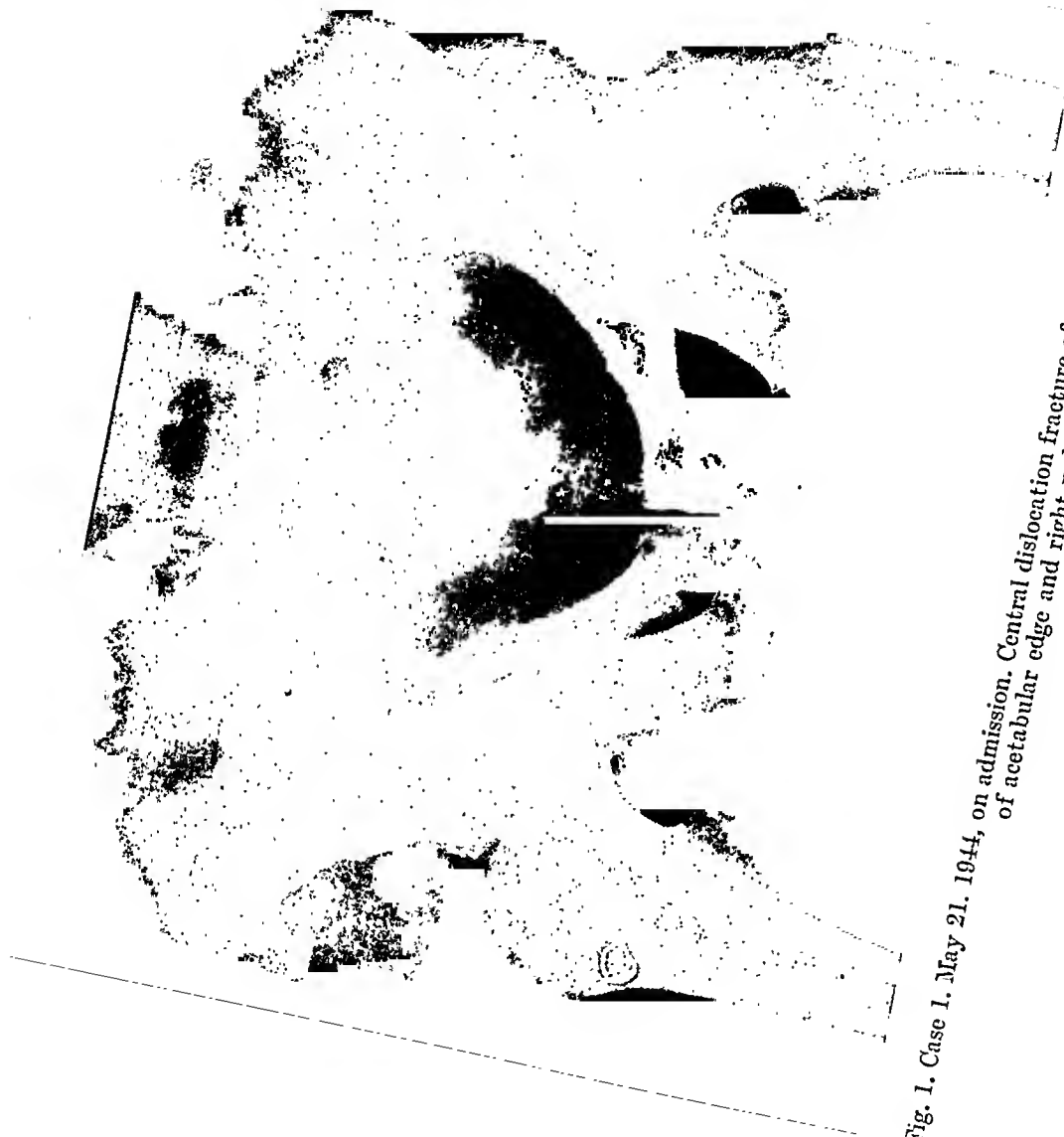


Fig. 1. Case I. May 21. 1944, on admission. Central dislocation fracture of the right hip joint, fracture of acetabular edge and right pubic bone.

QUIST-HANSEN: Necrosis of the Femoral Head.



Fig. 2. Case 1. August 4, 1944. Redislocation after removal of traction. Decalcification of the neck, and defect at summit of the mottled head.



Fig. 3. Case 1. April 17, 1945. Femoral head almost disappeared. Pronounced deformation of acetabulum.





Fig. 4. Case 2. April 12, 1941. Isolated fracture of greater trochanter two days after injury.



Fig. 5. Case 2. February 17, 1942. Flattening of femoral head with densely calcified summit. Healed fracture of greater trochanter.



Fig. 6. Case 2. February 1, 1943. Sequestered summit of head separated from the rest of the head by a band showing reduced density. No loss of cartilage space.

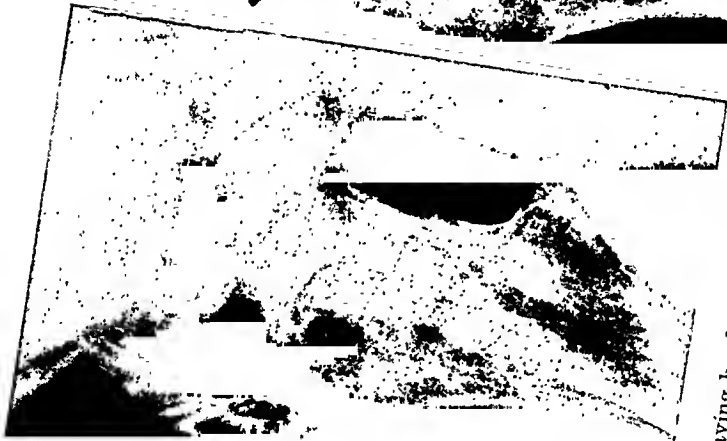


Fig. 7 a & b. Case 2. Juni 19. 1943. Sequester resorbed leaving bowlshaped defect in the head. Formation of new bone, especially on lateral margin of head.

Fig. 8. Case 2. March 24. 1945. Increased formation of new bone with reduction of head defect. Acetabulum deformed, but well adapted to the head. Broad translucent zone of joint cartilage. Athrodesis graft fractured at arrow.



to the recurring injuries during walking, by which the resorption and reorganisation of the dead bone tissue is prevented. Pseudarthrosis with the formation of connective tissue, as has been described (29 b, 43 b), was hardly present in my above case. Some sclerosis of the heads surface underlying the sequester may speak in favour of a pseudarthrosis, but the resorption of the sequester during  $4\frac{1}{2}$  months' recumbency speaks against it. The reparative processes were favoured by the immobilisation for two weeks previous to, and three months after the arthrodesis had been performed, and later on by the arthrodesis itself. The time of fracture of the arthrodesis graft cannot be fixed, but reorganisation of the head at that moment must have been far advanced since strain on the deformed hip was not painful.

In avascular necrosis the deformation of the femoral head is very uniform, and localised to the point of maximum pressure. It is evident that the flattening of the necrotic head depends on the pressure exerted on it (1, 18, 43 b). Only during a limited space of time, the 2nd and 3rd month after injury, the total necrotic area may be demonstrated by X-ray. When the head has already collapsed the dense area observed tells little about the originally avascularised area of the head. Nevertheless we have reason to believe that the necrosis very often actually is a circumscribed one in an otherwise vital head. Many authors therefore assume partial necrosis to be due to a disruption of the vessels in the round ligament. In case of lateral fracture of the femoral neck it has been imagined that a rotation of the head, caused by the injury to the hip, might rupture the round ligament (41). This has been observed (22), but is denied by SCHMORL (46 a). Post-mortem rupture of the ligament without simultaneous damage to the joint capsule has been induced (8), but it was attained only by a combination of movements which is absent in common hip injuries.

In cases of central dislocation fracture of the hip joint with pronounced dislocation of the head there is great probability of vascular disruption. Yet, caput necrosis did not occur (14, 19, 31, 53). If disruption of the vessels were the sole cause of the necrosis we must assume that disruption has taken place in the cases reported by CHANDLER and KREUSCHER, BANKS, and in my above case, in spite of the slighter dislocation present.

In my case of isolated fracture of the greater trochanter one might suppose a disruption of the upper capsular artery as

PHEMISTER does in his case. In both cases, however, the existing dislocation does not make a disruption of the artery evident. The persistence of the lateral margin of the head and the formation of new bone here, in my case rather indicate a preserved blood supply through the upper capsular artery (27, 36).

Disruption of the arteries in the joint capsule or within the neck cannot be the cause of caput necrosis in case of subtrochanteric fissure (29 a & b) which should be immune from that complication (52), and cannot explain necrosis of the head observed after mere contusions of the hip joint (13, 16, 20, 28).

Apart from avascular necrosis of the femoral head occurring in caisson disease (26, 43 c, 51), it is still a problem how ischemia develops in cases in which disruption of the nutrient arteries by fracture or dislocation cannot be assumed. MUTSCHLER believes that what he calls "subfractural lesions", indetectible by X-ray may cause disruption of the capillaries of the head (37), and NIELSEN, with support of investigations carried out by BENTZON (2), supposes the injury to affect the vascular nerves, which then interfere with the blood supply to the head (38). Up to now none of these theories have been proved, nor the suggestion that hip contusion should cause thrombosis of the nutrient vessels.

In most cases of avascular necrosis of the femoral head there is a demonstrable or probable disruption of its nutrient arteries caused by fracture of the neck, rupture of the joint capsule or of the round ligament. In other cases, however, it is not possible to assume disruption of these vessels. In all cases there has been an injury to the hip joint. Although we do not know how the uncomplicated injury to the hip produces avascular necrosis of the femoral head, we are not justified to look exclusively to disruption of the nutrient vessels, even in cases where it may possibly exist.

### Summary.

Avascular necrosis of the femoral head after central dislocation fracture of the hip joint and isolated fracture of the greater trochanter appears to be rare. The author describes a case of caput necrosis after each of these injuries.

Case 1. A man, aged 63, suffered central dislocation fracture of the hip joint by direct injury to the hip. Twelve weeks later X-ray examination revealed necrosis of the femoral head, and in the 20th week there was advanced resorption of the head. After

11 months the head had almost disappeared and the neck had entered into the deformed acetabulum. Nevertheless, the functioning of the joint was fairly good and the patient was free from pain.

Case 2. A 15-year-old boy sustained an isolated fracture of the greater trochanter by direct injury to the hip. After 8 months without symptoms the joint began to trouble him, and a roentgenogram demonstrated caput necrosis with tendency to subluxation of the head. A shelf operation one year after the injury gave temporary relief. Half a year later there was a limited caput sequester which was resorbed after  $4\frac{1}{2}$  months' recumbency. As the joint still gave him considerable trouble, extraarticular arthrodesis was performed, since when the patient has been free from pain. Four years after the original trauma the arthrodesis graft was fractured, he had mobility in the hip, and the defect in the femoral head was reduced.

Disruption of the nutrient arteries to the femoral head can furnish a satisfactory explanation in most cases of post-traumatic, avascular caput necrosis, but not in all cases. In the author's first case it is difficult to see how the upper capsular artery could have been ruptured, and in the second case the slight dislocation, the persistence of the lateral margin of the head and the formation of new bone here seem to speak against disruption of the upper capsular artery. In simple contusions of the hip joint we have no reason for assuming disruption of the capsular arteries, and rupture of the round ligament also seems doubtful. Although it is not clear how an uncomplicated injury to the hip can lead to avascular necrosis of the femoral head it is not justifiable to look exclusively to disruption of the nutrient vessels, even in cases where it may probably or possibly exist.

### Zusammenfassung.

Aseptische Nekrose des Schenkelkopfes nach zentraler Hüftverrenkung und nach isoliertem Bruch des grossen Trochanters scheint selten zu sein. Verf. berichtet über einen Fall von Hüftkopfnekrose nach jeder dieser Verletzungen.

Fall 1. Ein 63-jähriger Mann erhielt eine zentrale Hüftverrenkung durch direkten Stoss auf die Hüfte. Elf Wochen später wurde eine Nekrose des Hüftkopfes durch Röntgenuntersuchung festgestellt, und in der zwanzigsten Woche lag eine weitgehende

Resorption des Kopfes vor. Nach elf Monaten war der Gelenkkopf beinahe verschwunden, und der Schenkelhals war in die verunstaltete Gelenkhöhle eingetreten. Trotzdem war die Funktion des Gelenkes ganz gut, und der Kranke hatte keine Schmerzen.

Fall 2. Ein 15-jähriger Knabe erhielt einen isolierten Bruch des grossen Trochanters durch direkten Stoss auf die Hüfte. Nach acht Monate ohne Symptome fing er an Hüftbeschwerden zu haben, und eine Nekrose des Schenkelkopfes wurde mittelst Röntgenuntersuchung entdeckt. Pfannendaehplastik führte vorübergehende Besserung herbei. Ein halbes Jahr später lag ein begrenztes Sequester im Kopfe vor, das nach  $4\frac{1}{2}$  monatlicher Ruhe resorbiert worden war. Da der Kranke fortfahrend beträchtliche Hüftbeschwerden hatte, wurde eine extraartikuläre Arthrodesse ausgeführt, und er ist seitdem ohne Schmerzen gewesen. Vier Jahre nach der ursprünglichen Verletzung war die zur Arthrodesse verwendete Knochenspanne gebrochen, der Kranke konnte im Hüftgelenk bewegen, und der Aussparung im Schenkelkopf war verkleinert worden.

Zerreissung der ernährenden Arterien des Schenkelkopfes gibt eine zufriedenstellende Erklärung der Mehrzahl der Schenkelkopfnekrosen, aller Fälle aber nicht. Im ersten Fall des Verfassers ist es schwer zu sehen wie eine Zerreissung der oberen Kapselarterie hätte stattfinden können, und im zweiten Fall scheint die geringe Verschiebung, das Erhaltenbleiben des lateralen Kopfrandes und die dortige Aufbau neues Knochengewebes eine Zerreissung der oberen Kapselarterie eher wiederzusprechen.

Bei der unkomplizierten Hüftkontusionen haben wir keine Veranlassung eine Zerreissung der Kapselarterien anzunehmen, und auch eine Berstung des runden Bändchens scheint zweifelhaft zu sein.

Obwohl es nicht klar ist wie die unkomplizierte Hüftkontusion eine ischämische Kopfnekrose herbeiführen kann, ist man, eben in den Fällen wo sie wahrscheinlich oder möglich scheint, nicht berechtigt ausschliesslich eine Zerreissung der Gefässe in Erwägung zu nehmen.

### Résumé.

Il paraît que la nécrose de la tête fémorale après luxation centrale de la hanche, et fracture isolée du grand trochanter soit rare. L'auteur rapporte un cas de nécrose après chacune de ces lésions.

Cas 1. Un homme âgé de 63 ans a attrapé une luxation centrale de la hanche par coup direct. Douze semaines plus tard la radiographie démontre une nécrose de la tête fémorale, et dans la vingtième semaine on trouve une résorption avancée de la tête. Après onze mois la tête était à peu près disparue, et le col avait entré dans la cotyle déformée. Néanmoins la fonction du joint était assez bonne, et le malade était sans douleurs.

Cas 2. Un garçon de 15 ans eut une fracture isolée du grand trochanter par coup direct sur la hanche. Après huit mois sans symptômes le joint a commencé à lui causer des troubles, et la radiographie démontrait nécrose de la tête fémorale qui tendait à se subluser. Un an après l'accident une butée ostéoplastique amenait une amélioration passagère. Six mois plus tard on trouvait dans la tête un séquestre limité qui, après 4½ mois de repos, était résorbé. A cause des troubles considérables qu'avait toujours le malade de sa hanche, une arthrodèse extraarticulaire était faite, et après cela il était sans douleurs. Quatre ans après la contusion originale la greffe immobilisant la hanche était cassée, la hanche était mobile et le défaut de la tête fémorale était réduit.

Une rupture des artères nutritives de la tête fémorale peut, le plus souvent, donner une explication satisfaisante des nécroses posttraumatiques de la tête, mais pas toujours. Dans le premier cas de l'auteur on a de peine à voir comment soit rompu l'artère capsulaire supérieure, et dans le deuxième cas la dislocation peu prononcée, la persistance du bord latéral de la tête et de l'os nouveau formé en cet endroit paraissent plutôt rendre invraisemblable une rupture de l'artère capsulaire supérieure.

En cas de contusions simples de la hanche nous n'avons pas de raison d'assumer qu'une rupture des artères capsulaires n'ait eu lieu, et aussi une rupture du ligament rond paraît douteux.

Bien qu'il ne soit pas clair comment la contusion simple de la hanche peut aboutir à une nécrose avasculaire de la tête fémorale, il n'est justifiable de prendre en vue exclusivement la rupture des vaisseaux, même en des cas où elle peut possiblement ou probablement exister.

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## **Acute Interstitial Pancreatitis Provoked by Haemolytic Streptococci in Infected Food (Fish).**

By

ODDMUND KOLLER.

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To judge by the literature on the subject, acute bacterial pancreatitis would seem to be very rare. It is often mentioned in the literature of older date, but it is obviously confused with acute necrosis of the pancreas. DIECKHOFF and GRUBER (1) have described acute purulent inflammatory processes of canalicular origin, with multiple abscesses and only insignificant fat necrosis. GRUBER (1) has also described a couple of cases of acute interstitial pancreatitis without purulent decomposition, an ascaris in the ductus Wirsungianus being responsible for this condition in one of these cases. But in neither of them is anything said concerning the discovery of microbes. In addition to bacterial pancreatitis of canalicular origin, there is also a group of cases in which the infection is probably conveyed by the blood stream as in cases of parotitis and certain other acute infectious diseases. PETTINARY (2) has reported a case of acute interstitial pancreatitis verified by histological examination and, in his opinion, of haematogeneous origin. In the literature available to me, I have been unable to find any account of acute interstitial, non purulent, bacterial pancreatitis in which the diagnosis was verified both by a bacteriological and by a histological examination. The following two cases belong to this category.

## Case Report.

*Nr. 1 (O—249/45).*

On August 28, 1945, a man aged 64 was admitted to the Surgical Department of Haukeland Hospital with the diagnosis of acute abdomen. He had on the whole been well until, on the morning of August 26, he felt pain across the abdomen at the level of the umbilicus, radiating to both flanks and the small of his back. This pain was so violent that he groaned aloud, and it was accompanied by frequent vomiting of malodorous, bile-stained fluid. No faeces nor flatus had been passed during the last 12 hours preceding admission to hospital. The patient was much exhausted, his temperature was 38.8, his pulse 80 (r), his blood-pressure 110/65, and his tongue dry. His large abdomen was distended and rigid, particularly in its upper half in which there was an area as hard as a board. No intestinal sounds were audible. As he was obviously suffering from peritonitis, an exploratory laparotomy was performed under gas and ether. There was a little viscid, greyish-yellow fluid in the peritoneal cavity and remains of an old appendicitis with firm, fibrous adhesions. The gall-bladder was somewhat tense, but no stones were palpable. There was some gelatinous oedema extending from about the lower part of the duodenum downwards along the ascending colon. The operator finding that the changes observed probably originated from the pancreas, introduced a drain and closed the operation wound. A bacteriological examination of the effusion in the peritoneal cavity showed haemolytic streptococci in pure culture. The patient's condition became worse and he died on August 29, three days after the onset of his illness.

An external examination undertaken 24 hours after death showed strikingly obvious, blue-violet markings on both flanks. The abdominal cavity when opened contained a little blood-stained fluid. The oedematous duodenum was somewhat distended by blood, and there was considerable oedema of the retroperitoneal tissue, particularly in the neighbourhood of the pancreas which was swollen and humid. The gallbladder was definitely more distended than normal, but the biliary passages were permeable and contained no stones. The surface of the brain was congested with blood and oedematous, and there was a slight flattening of the convolutions. But the brain was otherwise not abnormal.

A microscopic examination of the pancreas showed considerable infiltration with leucocytes, mainly polymuclear granulocytes which were interlobular and, to some extent, interacinar. There was considerable oedema and some patchy degeneration of the epithelium, but there was no evidence of fat necrosis or haemorrhage. Passages leading to the exterior were few in number and ill-preserved. A Gram-stained preparation showed numerous Gram-positive cocci in short chains.

*Nr. 2 (R—47/45).*

A couple of days later, a general practitioner informed us that a man, aged 75, who had lived with the first patient and who had fallen

ill with similar symptoms, had died in his home on August 31. As the general practitioner suspected food poisoning, the body of this man was brought to Dr. F. G. GADE's Pathological-Anatomical Laboratory for a medico-legal post-mortem examination into the cause of his death. Subsequently, enquiries addressed to his relatives yielded the following data. He had fallen ill with gastric symptoms on August 27, about 24 hours after the first patient had done so. Like the first patient, he had suffered from colic-like pain in the abdomen and back, but it had not been so severe. A brief period of diarrhoea had been followed by constipation. Though his hands and feet were cold as ice, he complained of feeling hot. Like the first patient, he vomited malodorous, bile-stained fluid, and his death was quite sudden on August 31, 1945, after being ill for five days.

As in the first case, a post-mortem examination showed vivid, blue-violet, venous markings on the surface of the body. There were advanced arteriosclerotic changes in the coronary arteries, but they were not completely obliterated, and there was no infarct of the muscles of the heart. The abdominal cavity contained about 150 c. c. of a dirty brown fluid. The duodenum was congested and oedematous. Here, too, there was retroperitoneal oedema most marked in the neighbourhood of the pancreas which also showed definite oedema but no macroscopic evidence of necrosis. The spleen was large and soft, showing blurred markings. The mesentery was distended with blood and oedematous, and it contained somewhat swollen lymphatic glands. Further, there was considerable oedema of the brain, but nothing noteworthy on section. Blood cultures from the heart and spleen yielded haemolytic streptococci in pure culture.

A microscopic examination of the pancreas showed massive infiltration with leucocytes, mainly polynuclear granulocytes which were interlobular and interacinous. There was much oedema, but no fat necrosis nor haemorrhage. Passages leading to the exterior were few in number and ill-preserved. A Gram-stained preparation showed numerous Gram-positive cocci in short chains.

### Nr. 3.

The medico-legal post-mortem examination of the second patient was undertaken because food poisoning was suspected. The dead man's relatives stated that a third person, a man, in the same household, had also been ill at about the same time with abdominal pain and diarrhoea which had not lasted much more than 24 hours. A bacteriological examination of this patient's faeces showed only the colon bacillus. On October 18, 1945, *i. e.* nearly eight weeks after his attack of diarrhoea, his blood was examined for antifibrinolysin according to the procedure described by E. WAALER in 1937 (3). Much antifibrinolysin being found in the blood, it was evident that the patient had recently undergone an infection with quite virulent streptococci. This patient stated, that he had always been well and that in recent times in particular he had suffered from no infected wounds, erysipelas, sore throat nor other ailment which could conceivably have been due to strepto-

cocci responsible for an increased antifibrinolysin content of the blood. It seems therefore reasonable to assume that his abdominal ailment had been provoked by streptococci.

Further enquiries showed that all these three persons had been members of the same household which was composed of five persons, including a mother and infant. On August 24, all of them had eaten salted blue halibut at the midday meal. None of them had fallen ill. Next day, only the three male members of the household partook of the blue halibut warmed up. All three fell ill, the first and third patient in the following night, and the second patient about 24 hours later. The first patient, who presented the most stormy clinical picture, had found the blue halibut so much to his taste that he had eaten a considerable quantity of it by himself on the same evening. None of the three patients had eaten any uncooked food, nor had they drunk milk.

### Discussion.

Two elderly men, who shared board and lodging, developed about the same time violent abdominal pain which radiated to the back and was accompanied by vomiting. The illness proved fatal in three and five days respectively. The pathological-anatomical changes in both cases were remarkably similar. In both cases a little brown, cloudy fluid was found in the peritoneal cavity, and there was a gelatinous oedema of the duodenum, oedema and hyperaemia of the pancreas, of the retroperitoneal tissue, and distension with blood and oedema of the surface of the brain. In both cases, a microscopic examination showed interstitial pancreatitis with Gram-positive cocci in short chains. Haemolytic streptococci were found in pure culture in the peritoneal effusion in the first case and in the blood in the heart and in the spleen in the second case.

The possibility of a post-mortal invasion of bacteria could be excluded at any rate in the first case in which the sample taken for examination was secured at the time of the operation. It is also a very unlikely possibility in the second case in which haemolytic streptococci were obtained in pure culture from both heart and spleen. Further, numerous bacteria were found in direct preparations.

It seems therefore justifiable to trace the cause of death in both these cases to an acute bacterial pancreatitis provoked by haemolytic streptococci with simultaneous or secondary sepsis. It is probable that the blue halibut was the vector of the infecting

material, that it had become infected after the first cooking, and that the growth of bacteria had been very luxuriant from the one day to the next with the result that the three patients had taken a large dose of them. The youngest patient had recovered quickly and had suffered only from transitory signs of enterocolitis. The two elderly patients developed pancreatitis. The histological observation of few and ill-preserved passages leading to the exterior of the pancreas is suggestive of, but not proof positive of, a canalicular mode of propagation. What may however be considered as definitely proven is the responsibility of haemolytic streptococci for the development of the pancreatitis.

As already pointed out, I have been unable to find in the literature of the subject any account of cases, such as these two, of unquestionable, acute, bacterial, non-purulent pancreatitis. On the other hand, we are familiar with a form of acute pancreatitis whose pathological-anatomical features are completely identical with those of my two cases, but whose aetiology has been assumed to be different. This is the acute interstitial pancreatitis first described by ZOEPFFEL in 1922 under the name of pancreatitis oedematosa. According to BIRCHER (4) and SOUPALT (5) this is not an inflammatory process but the first stage of acute necrosis of the pancreas. In 1933, ELMAN (6) published a critical analysis of 37 cases, four of which were his own, with a microscopic examination of the pancreas in six cases. He describes the pathological-anatomical picture as composed of oedema, swelling and induration of the pancreas, but without necrosis, haemorrhage or suppuration. The histological picture shows marked infiltration with polynuclear cells between the lobules and also between the acini, often with signs of oedema. There is no great difference between his description and the micro-photographs he publishes on the one hand, and what I have found in my two cases. He comes to the conclusion, among other things, that acute interstitial pancreatitis is probably provoked by the reflux of bile into the duct of the pancreas.

This conception of the pathogenesis of acute interstitial pancreatitis is open to an important objection, at any rate in the way in which ELMAN has presented his cases, in none of which a bacteriological examination is mentioned.

Our two cases show clearly the importance of a bacteriological examination without which they would have been diagnosed as cases of acute interstitial pancreatitis whose aetiology and

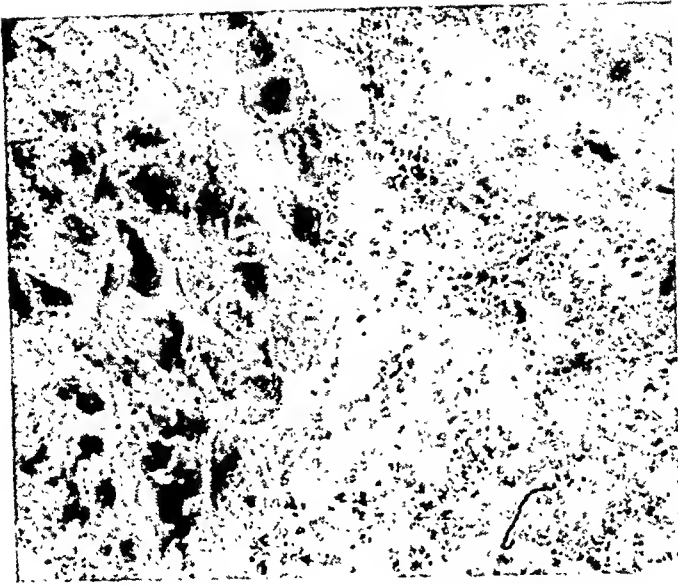


Fig. 1. Numerous Gram-positive cocci in short chains in the areas infiltrated by leucocytes.

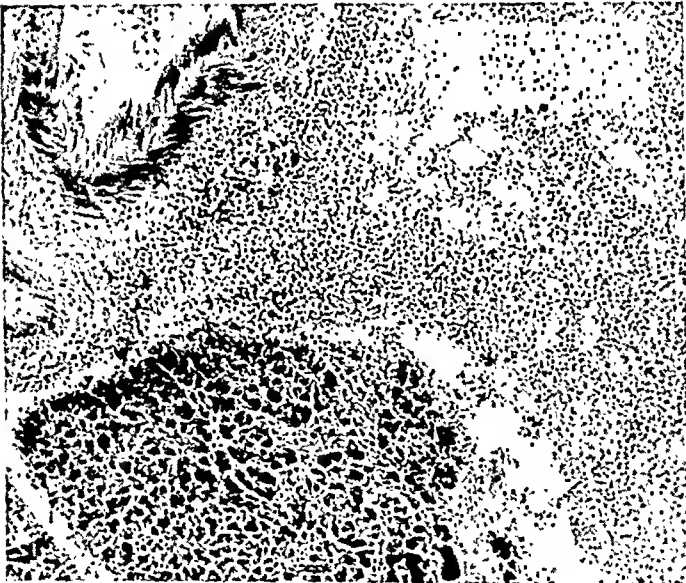


Fig. 2 and 3. Fig. 2 shows massive infiltration with leucocytes in the interlobular tissue and large fields of oedema.

KOLLER: Acute Interstitial Pancreatitis.

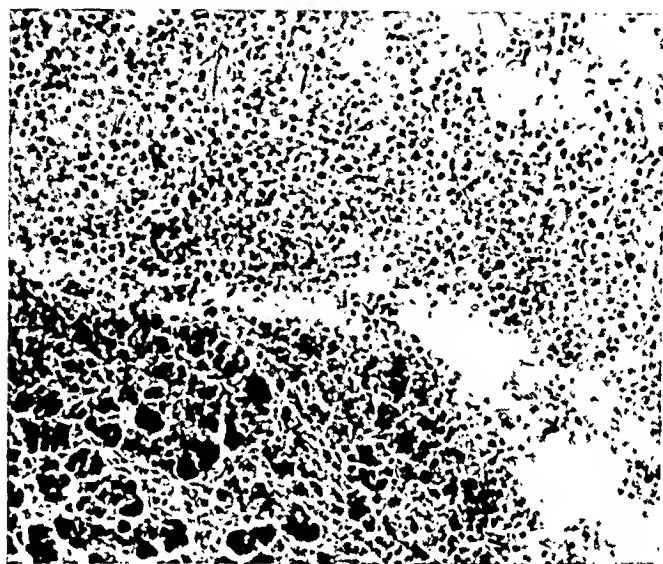


Fig. 3 is a section of fig. 2 enlarged. The leucocytes are mainly polynuclear granulocytes, interlobular and also interacinous.

pathogenesis are for the most part still in the realms of the hypothetical.

In this connection it may be noted that data concerning bacteriological investigations of cases of acute necrosis of the pancreas are conspicuous by their rarity when we study the literature of the subject. LEWISON (7) writes: "Careful bacteriological studies of acute pancreatic necrosis are singularly meagre." This is quite surprising considering that the aetiology of acute necrosis of the pancreas cannot yet be said to be clearly understood. Several experimental studies suggest that bacteria may play an essential part in this process. Here it is sufficient to recall the investigations by ARCHIBALD (8) in 1919, when he provoked necrosis of the pancreas in cats by injecting bile into the duct of the pancreas. He wrote: "The severe cases with early death were all in the series in which infected bile was used. Sterilized mucin-free bile and the bile salts in solution caused, it is true, necrosis of the gland, but of degree easily consistent with recovery, while the infected ox-bile almost regularly caused early death usually with, occasionally without, severe lesions in the pancreas."

The few reports on bacteriological findings in cases of acute necrosis of the pancreas are quite divergent. GULEKE (9) writes that bacteriological examinations of effusions into the peritoneal cavity and of the pancreas in an early stage of necrosis have almost invariably yielded negative results, but he does not mention any figures. BRÜTT (10) has quoted 33 cases of pancreatitis in which attempts were made to carry out bacteriological examinations of an effusion into the peritoneal cavity, of bile, of the pancreas and of the liver. Bacteria were found in fully one-third of the cases examined. SCHMIEDEN and SEBENING (11) have given an account of 282 cases which were examined; the effusion into the peritoneal cavity was found to contain bacteria in 103 cases, whereas it was sterile in 84. The bile was infected in 54 cases, sterile in 40. The bacteria found were staphylococci, streptococci, *b. coli*, FRAENKEL's gas gangrene bacillus, para-typhus B., and *baet. lactis aerogenes*.

To be sure, a secondary infection may have occurred in several of these cases. But it is possible that in a certain number of them the infection may have been primary and responsible for the activation of the enzymes. We can also not disallow secondary infections a certain influence on the intensity and extent of the necrosis of the pancreas (cf. ARCHIBALD's investigations). There is



further the possibility of secondary sepsis which may be the cause of death in a certain number of cases.

On the whole, there are good grounds for emphasizing the great importance of bacteriological investigations of cases in which acute pancreatitis is suspected. In cases in which operative treatment is undertaken, it should be possible to carry out a thorough bacteriological investigation. When treatment is conservative — and these cases are assuredly in the majority — blood cultures should be taken, the faeces should be examined, and the antistreptolysin content of the blood should be determined.

In the light of the facts just mentioned, and considering how helpless we have hitherto been in combating acute pancreatitis (including necrosis of the pancreas), it seems natural to give sulphonamides or penicillin a trial.

### Summary.

The author gives an account of two cases of acute, interstitial, non-purulent pancreatitis provoked by haemolytic streptococci, and of one case of acute enterocolitis with a raised antistreptolysin titre. It appears that all three cases originated in the consumption of infected fish. The pathological-anatomical picture was indetical with that of ZOEPFFEL's pancreatitis oedematosa and ELMAN's acute interstitial pancreatitis which is generally interpreted as an aseptic process, possibly as the initial stage of acute necrosis of the pancreas.

In his comments on these cases, the author points out that the factors responsible for the development of acute necrosis of the pancreas are still shrouded in obscurity. Earlier experimental investigations have shown that bacteria may play a decisive or contributory part in activating the enzymes of the pancreas. The quite scanty figures dealing with bacteriological findings in cases of acute necrosis of the pancreas show that a considerable portion of them were infected. The author stresses the need for careful bacteriological examinations, and he recommends as a routine measure, in cases given conservative treatment, the examination of the patient's faeces and blood, as well as the determination of the antistreptolysin content of the blood. Positive bacteriological findings should be a definite indication for chemotherapy. It is also conceivable that primary, aseptic necrosis of the pancreas

ought to be given chemotherapeutic treatment with a view to preventing secondary infections with consequent intensification of the process and septicaemia.

### Zusammenfassung.

Der Verfasser berichtet über 2 Fälle von akuten, nicht eitrigen Pankreatitis, die von hämolytischen Streptokokken hervorgerufen waren, und 1 Fall von akuter Enterokolitis mit erhöhtem Antistreptolysintiter. Es wird angenommen, dass alle 3 Fälle mit infizierter Fischeispeise herbeigeführt sind.

Das pathologisch-anatomische Bild war mit Pankreatitis oedematosa (ZOEPPFEL), acute interstitial pancreatitis (ELMAN) identisch, möglicherweise der erste Anfang der akuten Pankreasnekrose.

In Verbindung mit diesen Fällen weist der Verfasser darauf hin, dass die auslösende Faktoren der akuten Pankreasnekrose noch nicht aufgeklärt sind.

Frühere experimentelle Untersuchungen zeigen, dass Bakterien eine entscheidende oder mitwirkende Rolle in der Aktivierung der Pankreasenzymen spielen können. Die übrigens spärliche Statistiken über bakteriologische Befunde bei der akuten Pankreasnekrose zeigen, dass ein erheblicher Teil der Fälle infiziert ist. Die Notwendigkeit von bakteriologischer Registrierung wird präzisiert, und in der konservativ behandelten Fällen schlägt der Verfasser routinemässige Untersuchungen von Stuhl und Blut vor, und ausserdem Bestimmung vom Antistreptolysintiter.

Bei positiven bakteriologischen Befunden hat man eine sichere Indikation für Chemotherapie. Es ist auch möglich, dass man primär aseptische Pankreasnekrose auch so behandeln sollte, um eine sekundäre Infektion und die damit folgende Intensivierung des Prozesses und Sepsis zu verhindern.

### Résumé.

L'auteur relate deux cas de paneréatite interstitielle aiguë, non purulente, provoqués par le streptocoeque hémolytique, et un cas d'entérocolite aiguë avec un titre élevé d'antistreptolysines. Tous ces trois cas semblent être consécutifs à la consom-

mation de mets de poisson infectés. L'image anatomo-pathologique fût identique à celle de la pancréatite oedémateuse (ZOEPPFEL) acute interstitial pancreatitis (ELMAN), qu'on considère en général comme un processus aseptique, peut-être le stade initial de la nécrose aiguë du pancréas.

L'auteur note à propos de ces cas que le facteur déterminant la nécrose aiguë du pancréas n'est pas encore élucidé. Des recherches expérimentales précédentes montrent que des microbes peuvent contribuer ou avoir même le rôle décisif dans l'activation des enzymes pancréatiques. Les statistiques bacteriologiques, d'ailleurs peu nombreuses, en cas de nécrose aiguë du pancreas relèvent un chiffre élevé de cas infectés.

On souligne l'importance d'un contrôle bactériologique exact et on propose l'examen systématique du sang et des selles des malades traités conservativement, de même que la détermination du titre des antistreptolysines. Les cas bactériologiquement positifs sont justiciables de la chimiothérapie est en outre possible que les cas primitivement aseptiques doivent être également traités, pour prévenir ainsi l'infection secondaire, qui à son tour peut conduire à l'intensification du processus et à une sépticémie éventuelle.

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## **Normal and Pathological Bone Growth in the Light of the Development of Cartilaginous Foci in Chondrodysplasia.**

By

A. LANGENSKIÖLD.

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Growth disturbances and congenital anomalies develop on the basis of partial arrest or other changes in the normal process of development. A condition for fully understanding the genesis of disturbances in the development is that the course of the normal development in the regions in question is known. On the other hand disturbances in the development may give us valuable information on the course of the normal development. BENTZON wrote about Ollier's disease in 1924: "I believe that a full inquiry into the nature of this rare disease might throw a new light on several hitherto dark points in the question of the growth and regeneration of the bones."

### **The normal bone growth in the light of the development of cartilaginous foci in Ollier's disease.**

Ollier's disease is a rare system disease of the growing skeleton. This disease, enchondromatosis and the multiple cartilaginous exostoses form a group of diseases which in England and America has been called chondrodysplasia. Ollier's disease is characterized by longitudinal foci of cartilaginous tissue occurring in the metaphyses and the diaphyses of the tubular bones, in the pelvis and the scapulae etc. In roentgenograms these foci are of a very characteristic shape: "... mainly longitudinal, stripe-

shaped sharply limited areas in the bone itself; it looks as if long chips had been taken out of the bone with a gonge." (BENTZON). (Cf. fig. 1—5.)

OLLIER was of the opinion already in 1899 that the cartilaginous foci in the disease which later on was to carry his name, arise through parts of the epiphyseal plate forming cartilage which persists (of an unknown reason), and does not make way for the normal enchondral ossification. This cartilage persists in the shape of longitudinal foci which grow appositionally at their epiphyseal ends. This opinion on the genesis of the metaphyseal foci has been accepted by many authors and it is also proved by the observations in the examination of a typical case of Ollier's disease described by the author in *Acta orthopaedica scandinavica*. OLLIER did not explain, however, how the diaphyseal foci arise and in which relation these stand to the epiphyseal cartilage and the metaphyseal foci. Neither has anybody else later given any satisfactory explanation of this question.

One of the cases of this disease, described in a previous paper, furnished, thanks to roentgenograms having been made in two stages of development (at an age of 3.5 and 6 years), a clue to the elucidation of the development of the diaphyseal foci. These roentgenograms showed that the metaphyseal foci when the bone grows, gradually develop into diaphyseal foci and that this development takes place in a way schematically shown in fig. 6. The development of the foci is described in detail in the paper mentioned above.

In the places where the metaphyses exhibit changes in certain stages (fig. 6, II and III) the corner between the epiphyseal plate and the outer surface does not consist of bone but of cartilage. In stages I and II the base and growth zone of a focus must be considered a limited portion of the undifferentiated layer of the epiphyseal plate. It is evident that there is a disturbance in the histogenetical conditions at the limit between the epiphyseal plate and the periosteum and that this may be of importance to the development of the metaphyseal foci into diaphyseal. *In Ollier's disease the base of a focus during growth successively moves past the angle between the epiphyseal plate and the surface of the bone. This gave rise to the thought that the undifferentiated growth zone of a focus successively moves from the inner parts of the plate to the surface of the bone. This led to the question whether in normal postembryonic bone growth the undifferentiated connective tissue*

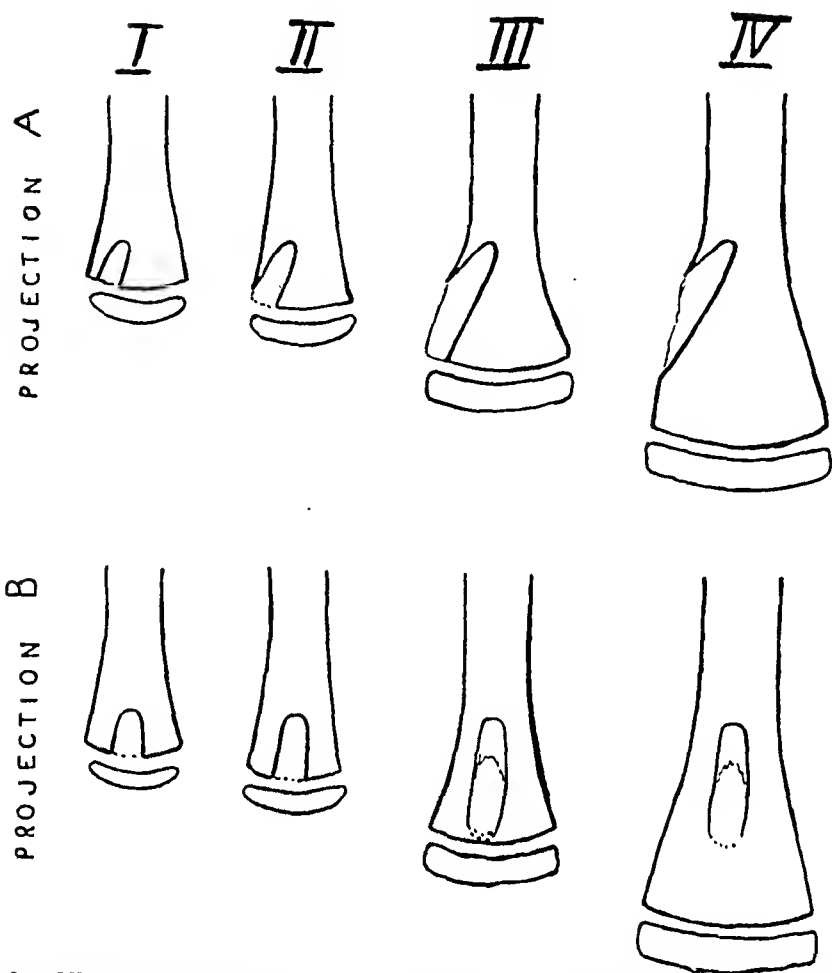


Fig. 6. Ollier's disease. Schematic drawing of the development of a metaphyseal focus into a diaphyseal one in the growth of the bone. Stage I—IV in two projections perpendicular to one another.

*within the epiphyseal plate possibly may be responsible for the normal formation of the osteogenic layer of the periosteum.*

The establishment of the different stages of development of the foci in Ollier's disease and the reflections caused thereby about a possible explanation of the histogenetical basis of this development, led to a study of the histological literature on the normal bone growth. In the large textbook on histology by v. MÖLLENDORFF (1930), there is a statement that the transition zone between the epiphyseal cartilage and the osteogenic layer of the periosteum was investigated in 1889 by RANVIER who called this zone "encoche d'ossification", ossification groove. In the said textbook WEIDENREICH writes: "No special attention was later paid to the histological and histogenetical conditions of the en-

coche zone." RANVIER wrote in 1889: "This groove apparently corresponds to a circular furrow around the epiphyseal cartilage. We shall soon see that it is important for the ossification." "... it is established that the portion of the periosteum corresponding to the groove consists of fibres originating in the cartilage itself." "These fibres which I have called arciform fibres, bend inwards reaching the surface of the embryonic bone. When they reach it the cells which follow them become more numerous assuming the character of osteoblasts." "*The cells forming the periosteal bone probably originate in cells of the cartilage, which are released with their fibres and follow them. The bone thus grows in thickness at the expense of a material furnished by the cartilaginous tissue. The growth in thickness of a long bone and its growth in length are thus found to be traced back to one and the same law.*"<sup>1</sup>

We may establish that RANVIER on the basis of histological investigations has described that normal histogenetical process, the existence of which seemed probable on the basis of the roentgenological investigation on the development of the foci in Ollier's disease.

Not only did RANVIER show in his work that the osteogenic layer of the normal periosteum originates in cells lying within the epiphyseal cartilage, but also that undifferentiated connective tissue cells in the periphery parts of the cartilage are differentiated into bone cells in the very edge of the diaphyseal bone tube bordering on the epiphyseal cartilage. This observation was later made also by CAREY, POLICARD and DAHL. It is obvious that also this process is included in the histogenetic disturbance occurring in the foci in Ollier's disease. Only few authors have later paid attention to the observations of RANVIER concerning the normal growth in length of the periosteal bone tube and the osteogenic layer of the periosteum. The numerous facts which are emphasized by POLICARD in his book on the growth of the long bones show clearly, however, that the histogenetical processes discovered by RANVIER have a central position in the mechanism of bone growth.

That the perichondrium may develop into periosteum seems to be a generally accepted fact. TODD wrote in 1913: "Osteoblasts are fibroblasts or connective-tissue cells which have undergone certain characteristic modifications and may or may not have passed through a 'chondroblast' stage."

A. W. HAM wrote in 1932 (in Special cytology by E. V. COWDRY):

<sup>1</sup> RANVIER, pages 342, 353, 357. The italics by the author.

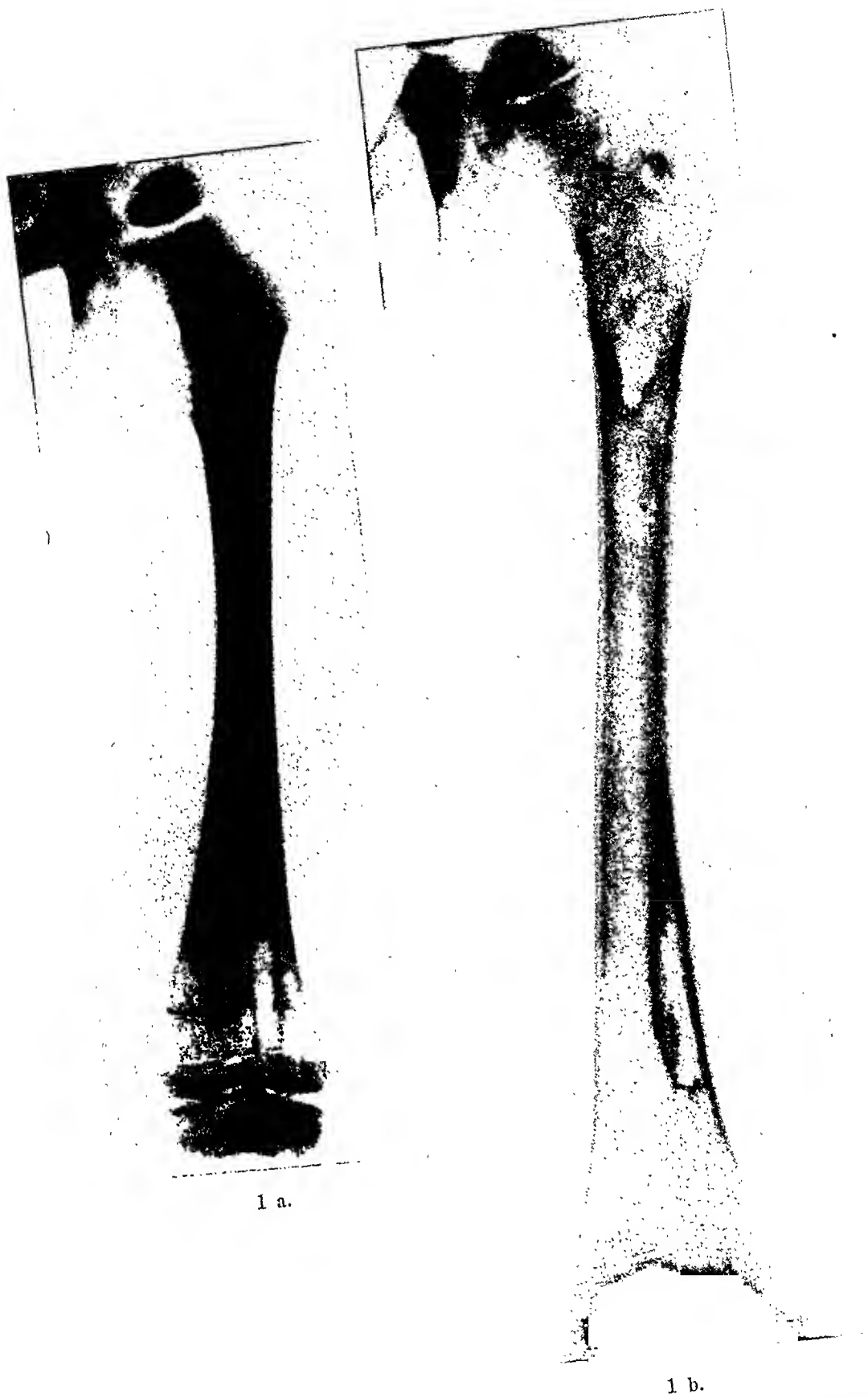


Fig. 1. Ollier's disease. a) left femur at an age of 3.5 years. b) at an age of 6 years.

LANGENSKIÖLD: Normal and Pathological Bone Growth.





3 a.

3 b.

Fig. 2. Side-view corresponding to fig. 1 b).

Fig. 3. Ollier's disease. a) right knee and leg at an age of 3.5 years. b) at an age of 6 years.



4 a.



4 b.

Fig. 4. a) side-view corresponding to fig. 3 a). b) side-view corresponding to fig. 3 b).  
LANGENSKIÖLD: Normal and Pathological Bone Growth.



Fig. 5. Ollier's disease. Left humerus.

"The differentiation of osteoblasts from the perichondrium demonstrates the inadequacies of terminology now in existence, because once bone formation ensues from this layer, its name must be changed to periosteum." The same facts are also stressed by SCHAFER in his textbook on histology. These statements all refer to the condition of the perichondrium on the surface of the embryonic cartilage rods; conditions in later stages when the epiphyseal plate has developed are not discussed from these points of view. WARWICK and WILES wrote in 1934: "The relation of periosteum to bone growth has been much discussed, but no direct or at any rate conclusive observations have been made on the growth of the periosteum itself." The investigations of these authors did not allow conclusions on the growth of the osteogenic layer of the periosteum and they will therefore not be dealt with here.

Although literature on enchondral and periosteal osteogenesis and on the cell rows of the epiphyseal cartilage is extensive, works on the proper undifferentiated layer of the epiphyseal plate and its origin and morphology are comparatively scarce. This undifferentiated connective tissue layer forms in the epiphyseal cartilage a comparatively complicated system in the so-called "cartilage canals". These were for the first time described by LANGER in 1872. Later on the cartilage canals have been described and their importance stressed by SCHMORL, M. B. SCHMIDT (1905, 1910) and STUMP.

The growth mechanism of the epiphyseal plate may be understood only in the light of the embryonic development of the bones. — The embryonic cartilage rods which are bases for the development of the tubular bones, are completely covered by an undifferentiated layer of connective tissue called perichondrium. When the cartilage rod in due time has been surrounded by a tube of bone the covering layer of connective tissue has commenced producing cells of osteogenic nature, and is now called the osteogenic layer of the periosteum. This osteogenic layer is directly connected with the perichondrium of the epiphyseal cartilage at the ends of the bone tube. At a comparatively early stage plugs of undifferentiated connective tissue grow, in places later corresponding to the epiphyseal plates, from the perichondrium in towards the centre of the epiphyseal cartilage (according to STUMP). These connective tissue plugs grow into the cartilage in several layers followed by blood vessels and forming the so-called cartilage canals. The layer of connective tissue which in these vessel-conveying canals fills the space between vessel and cartilaginous tissue, is the undifferentiated layer from which the cartilage growth of the epiphyseal plate sets out. In that stage of growth, in which epiphyseal plates have developed, the undifferentiated layer lies between the bone substance of the epiphysis and the real cartilage layer of the epiphyseal plate. This layer has been described by POLICARD in his book on the growth of the long bones as follows: "That layer of cartilage, which is in contact with the epiphyseal bone (reserve cartilage) shows transversal fibrils which, in the periphery of the epiphyseal cartilage, join the general fibrous system of the perichondrium. Actually, this layer is a perichondrium." (POLICARD, page 68.)

From this short description of what we know about the undifferentiated layer of the epiphyseal plate and its relation to the osteogenic layer of the periosteum appears that we have in the growing cartilage-preformed bones a continuous layer of undifferentiated connective-tissue stretching from the outer surface of the bone to the periphery of the epiphyseal plate and ramifying here right into its centre. The classic investigations of RANVIER together with results of later investigations by other authors indicate with fairly great probability that during the postembryonic bone growth a constant displacement of cells takes place in this continuous layer from the inner parts of the epiphyseal plate towards its periphery and towards the surface of the growing bone. Here these cells take on the character of cells of the osteogenic layer of the periosteum and give rise to the formation of osteoblasts and periosteal bone. The existence of this normal process of displacement, unnoticed by pathologists, may be considered confirmed by the manner of development of the cartilaginous foci in Ollier's disease. Such a continuous displacement of undifferentiated tissue layers is very common in the early embryonic development. This has been clearly shown by W. VOGT (1925, 1929) and other investigators in tests performed with groups of marked cells. VOGT (1925) points out that displacement of cellular material in later stages of growth probably is more common than is usually considered. Ollier's disease, nearly related to enchondromatosis, might be compared to an experiment by nature with groups of "marked cells" which only partly follow the laws of normal growth, differentiation and resorption. Limited portions of the undifferentiated layer of connective tissue of the epiphyseal plate form here a cartilage which of an unknown reason persists. These portions of connective tissue seem moreover at the displacement past the angle between the epiphyseal plate and the surface of the bone to retain their chondrogenic properties instead of merging at this limit in the osteogenic layer of the periosteum. The development of the foci in Ollier's disease shows that the central parts of the undifferentiated layer of the epiphyseal plate constitute a growth centre not only for the epiphyseal plate itself, but also for the osteogenic layer of the periosteum.

It is natural that the roentgenological establishment of the different stages of development of the foci in Ollier's disease does not alone throw any light upon the histogenetical processes. It is evident, however, that the development of this rare disease on

the basis of known histological facts may contribute to the elucidation of some of the more important processes in normal bone growth and that it seems to be able also to throw light on certain other branches within the pathology of bone growth.

### On the pathogenesis of some system diseases of the growing skeleton.

(*Multiple cartilaginous exostoses, enchondromatosis, Ollier's disease, achondroplasia, rickets.*)

Multiple cartilaginous exostoses, enchondromatosis, Ollier's disease, achondroplasia (*chondrodystrophia foetalis*) and rickets form a group of system diseases which, owing to certain common features, are often confused. The limits between the three first mentioned diseases seem to be so diffuse that they may, for excellent reasons, be grouped together as three different forms of disease under the common heading *chondrodysplasia*. Achondroplasia, however, exhibits a fairly distinct pathological picture even if its relation to the different forms of *osteochondrodystrophy* (*Morquio's disease, Silverskiöld's disease*) cannot be considered fully unraveled. All the diseases mentioned above have earlier been considered by many authors to be etiologically connected with rickets due both to clinical and pathological-anatomical similarities. The fact that rickets, being principally an exogenic disease, is not directly connected with the other distinctly genotypic diseases may now, however, be considered as certain.

A common feature in all these diseases is that they occur as system diseases in the growing skeleton, manifesting through disturbances in the course of the enchondral and perichondral ossification processes.

The pathogenesis of these system diseases has often been discussed in literature and different opinions have been expressed. This has particularly been the case in the discussion of the importance of the epiphyseal plates and the periosteum in the occurrence of the pathological-anatomical changes. It may be established, however, that most of the authors who discussed these problems have in one respect not been acquainted with the course of the normal bone growth. The osteogenic layer of the periosteum grows in length by means of a cellular material which

is displaced from the interior of the epiphyseal plate. Most authors in this field seem to have started from the obviously wrong idea that the osteogenic layer of the periosteum grows in length more or less independently of the growth of the epiphyseal plate and its undifferentiated layer. These problems have been subject to an analysis above. The classical discovery of RANVIER appeared to throw light on the development of the pathological-anatomical changes in the diseases mentioned above. The relation between the three different forms of chondrodysplasia has been discussed in a previous article in *Acta orthop. scand.* This article<sup>2</sup> did not, however, deal with the method of production of the cartilaginous exostoses in the light of the normal histogenesis in the transition zone between the epiphyseal cartilage and the osteogenic layer of the periosteum.

### Multiple cartilaginous exostoses.

(Hereditary deforming chondrodysplasia, Diaphyseal aclasis.)

Already VIRCHOW discussed the origin of the cartilaginous exostoses, assuming that they originated in detached portions of the epiphyseal plates. In 1913 MÜLLER denied the importance of the epiphyseal plate in this disease which he considered originating in a constitutional anomaly of the perichondrium and the periosteum. Since then several authors have dealt with this problem. Sir ARTHUR KEITH wrote in 1920: "It will be seen that the supposition that there is an arrest of development in the periosteal ring of the diaphyseal growth disc explains the appearances presented by the shafts of long bones in diaphyseal aclasis." (KEITH called the disease Diaphyseal aclasis.) "The arrest in the extension of the periosteal ring permits the cartilage of the diaphyseal disc to become exposed on the surface of the shaft and thus leaves it uncovered and free to give rise to irregular outgrowths or exostoses. A covering of periosteal bone exercises a restraining or a controlling influence on endochondral bone." The opinion of KEITH was adopted i. a. by LEWIN and JONES & LOVETT. JANSEN wrote in 1928: "... the cylindrical or barrelshaped area between the growth cartilage and the funnelshaped metaphysis is caused by a retardation of tubulation and exostoses are the result of partial retardation of tubulation. These two phenomena appear to us to be the result of a total and a partial dissociation through retardation of tubulation with regard to the other processes of longitudinal growth." COHN adopts in 1946 the opinion of JANSEN. GESCHICKTER & COPELAND stressed a disturbance in the development of the periosteum as a cause of the changes.

In multiple cartilaginous exostoses the tops of the pendunculated exostoses and the outer surfaces of the broadbased exostoses are covered by a cartilage layer, which corresponds to that of the epiphyseal

cartilage. KEITH did not consider himself to have found the whole solution of the problem of the histogenetical origin of the exostoses as appears from the following quotation: "It is very possible that besides the arrest of extension of the periosteal sheath, there is also an irregular grouping and division of the cartilage cells. Indeed I am inclined to suspect that the primary disturbance may prove to lie in the growth behaviour of the cartilage cells." — HUME considers the epiphyseal plate the foremost cause of the origin of the changes. He wrote in 1929: "It is considered likely that a portion of the periphery of the growth disc has become displaced on to the surface of the shaft, possibly by the pull of the periosteum attached to it." — GRANLEY, in 1939, wrote about the above theories: "None of these theories are completely satisfying and it would be surprising if they were, as the question of the cause and method of production of this condition involves the highly complex and fundamental problems of heredity and of bony growth."

We may establish that all these theories lack the foundation without which all efforts to explain the growth mechanism of the cartilaginous exostoses must be vague. This foundation is the knowledge of the course of the normal histogenesis in the transition zone between the epiphyseal plate and the osteogenic layer of the periosteum.

In normal bone growth there is a successive displacement of undifferentiated connective tissue cells from the inner parts of the epiphyseal plate towards its outermost edge where, giving rise to osteoblasts in the periosteum, they form its osteogenic layer. In the production of cartilaginous exostoses this continuous process of differentiation is evidently disturbed. GESCHICKTER and COPELAND have pointed out that the rise of cartilaginous exostoses is due to a disturbance in the differentiation of primitive connective tissue. These authors wrote: "This tendency to emphasize the chondral substance of these tumors instead of their connective tissue origin, particularly when they assume the form of multiple cartilaginous exostoses or hereditary deforming chondrodysplasia, has been the cause of much confusion in the attempts to interpret the nature of this multiple skeletal disease." — "The failure of pathologists to appreciate the relationship between normal bone development and tumor formation has been a continual source of difficulty."

The growth mechanism of the cartilaginous exostoses is assumably as follows: *Limited portions of the undifferentiated cell layer which by growth, is displaced from the interior of the epiphyseal cartilage to the surface of the bone, do not as would normally be the case give rise to cells of osteoblastic nature. These pathological por-*



tions of connective tissue retain their chondrogenic properties giving rise to the cartilaginous layer on the surface of the bone which forms the outermost zone of the exostosis. This cartilage layer grows and is replaced by enchondral bone according to the same laws as the cartilage in the epiphyseal plate itself. The undifferentiated connective tissue displaced from the interior of the epiphyseal plate which should have given rise to a layer of osteoblasts, gives instead rise to chondroblasts and cartilage. Owing to this local disturbance of the differentiation the formation of an osteogenic layer fails to occur in the corresponding places, and thus also the processes which are dependent on such an osteogenic layer, viz. the formation of periosteal bone and tubulation and modelling of bone. On account of the local disturbances of differentiation the limit between osteogenic and chondrogenic tissue does not keep pace in these places with the growth in length of the bone. (The abnormal place of the "encoche d'ossification" in exostotic bones has been pointed out by LEVEUF, but he does not give any explanation of this phenomenon.) When the pathological portions of connective tissue have passed the periphery of the epiphyseal plate the normal conditions at the limit between the plate and the osteogenic layer of the periosteum are re-established. If there is a disturbance of the cell differentiation only within a minor portion of connective tissue pedunculated exostoses are formed, if the change is more disseminated broad-based exostoses are formed leading frequently to the thickening of the bone ends characteristic of this disease.

The formation of the numerous cartilage isles discovered by MÜLLER, on the surface of the tubular bones in his case, finds its natural explanation in the fact that the connective tissue within the epiphyseal cartilage is the producer of the osteogenic layer of the periosteum after the early embryonic development. In the embryonic stage the perichondrium of the primary cartilage rods is transformed into an osteogenic layer. We cannot preclude the possibility that local disturbances in the differentiation process may occur already at this stage, giving rise to cartilage isles and later to exostoses. The production mechanism of the cartilaginous exostoses is schematically illustrated in fig. 7. The explanation of the method of production of the cartilaginous exostoses given above is strongly supported by the histological findings in this disease. This appears from the excellent histological picture published by LEVEUF.

Under the cartilage layers of the multiple exostoses a con-

tinuous enchondral ossification often takes place. In the roentgenograms of many authors there are, however, clear areas within the diaphysis itself inside the exostoses. These clear areas are of the same shape as the cartilaginous foci in Ollier's disease (roentgenograms published by LEVEUF, GESCHICKTER & COPELAND, MILANI and others). The shape of these areas points to their origin being similar to that of the foci in Ollier's disease. Such a longitudinal clear area in the diaphysis constitutes probably together with the exostosis a "trace" which indicates the course of the

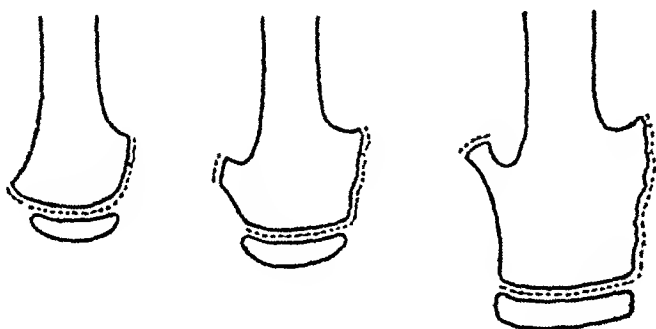


Fig. 7. Multiple cartilaginous exostoses. Schematic drawing of the development of the exostoses (three stages). The dotted lines indicate precartilaginous connective tissue.

apposition of cells from a pathological portion of connective tissue. In the exostosis disease a cartilage proliferation continues on the outer surface (fig. 8), while this is not to the same extent the case in Ollier's disease (fig. 6). Consequently there are only exostoses of a very small size in Ollier's disease. The occurrence of such foci which are schematically illustrated by fig. 8 indicates how closely related Ollier's disease is to the multiple cartilaginous exostoses. That these diseases in spite of the occurrence of intermediate forms cannot be considered quite identical has been stressed in a previous article (*Acta orthop. scand.*). These intermediate forms are probably one of the main causes of confusion existing in the terminology of these diseases.

If we compare the new viewpoints given above with the theories of other authors on the production method of cartilaginous exostoses we shall find that the contradictions between all these theories are, on the whole, only apparent. The cause of this disease seems to be a disturbance in the differentiation of limited portions of the undifferentiated connective tissue lying within the epiphyseal cartilage, the connective tissue which after the early em-

bryonic development constitutes a base tissue both of the epiphyseal cartilage tissue itself and the osteogenic layer of the periosteum. These portions of connective tissue only partly follow the laws of normal differentiation, growth and resorption and give rise to cartilage isles and exostoses. Whether we will count the cartilaginous exostoses among the tumors or not depends wholly on where we are drawing the limits between tumors and malformations. This was pointed out by v. KRESS in 1938.

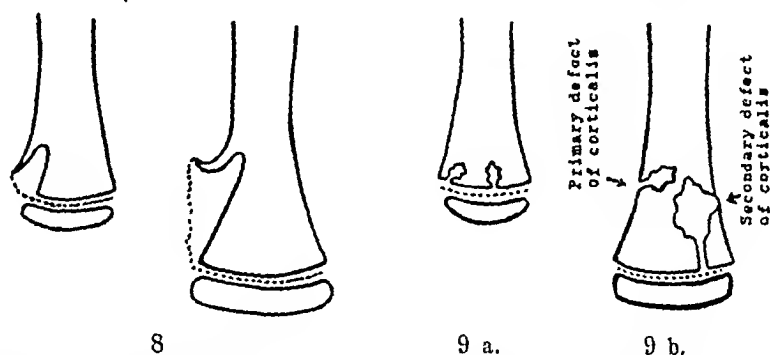


Fig. 8. Multiple cartilaginous exostoses. Schematic drawing of an exostosis combined with a roentgenologically clear area within the diaphysis (two stages). Drawn on the basis of roentgenograms of LEVEUF, MILANI and others.

Fig. 9. Enchondromatosis. Schematic drawing of the development of expansively growing true enchondromata (two stages, a and b). In the second stage the left enchondroma apparently sets out from the periosteum because its appositional growth zone has been displaced from the epiphyseal plate to the surface of the bone.

We do not know by means of which processes the genetic factors in chondrodysplasia give rise to the local disturbances of differentiation in bone growth. We cannot penetrate these problems without increased knowledge of the laws which determine the development of the fertilized ovum to a normal individual of a given species.

### Enchondromatosis and Ollier's disease.

In a previous article the development of the cartilaginous foci in Ollier's disease has been thoroughly discussed. The diffuse transition between this disease and enchondromatosis was also stressed. As far as enchondromatosis is concerned a further review of what is known about its pathology may be of interest.

SPEISER, whose work constitutes a principal part of the basis for our knowledge of the pathogenesis of enchondromatosis,

showed that some enchondromata in the case which was carefully examined by him, distinctly originated in the epiphyseal plate, while others had their base on the surface of the bone. This discovery caused SPEISER to deny VIRCHOW's theory on the impor-

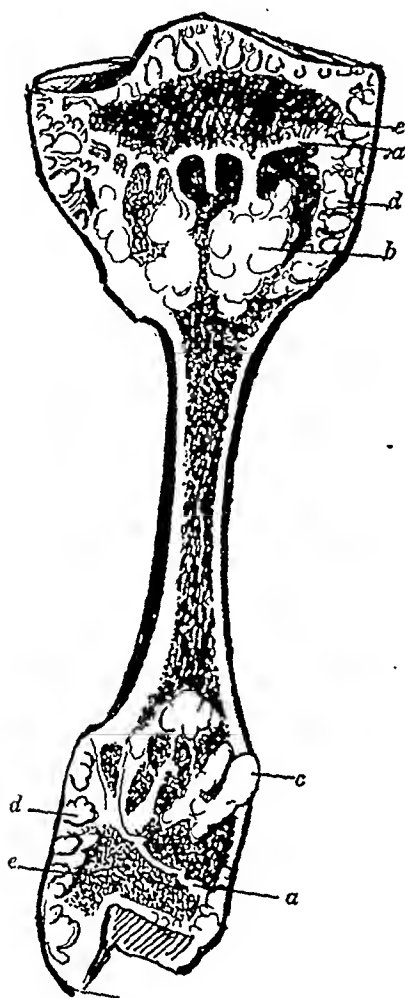


Fig. 10. Enchondromata of the tibia of Spciser's case.  
(From SPEISER's paper, 1925).

tance of the epiphyseal plate as the only basis for enchondroma production. The enchondromata, which are connected with and originate in the epiphyseal plate (cf. fig. 10 from SPEISER's paper) correspond absolutely, however, to the metaphyseal foci in Ollier's disease. There is hardly any doubt that the enchondromata which have their basis on the surface of the bone have originated in a way similar to the development of diaphyseal foci from metaphyseal foci in Ollier's disease. Both in Ollier's disease and enchon-

dromatosis there are thus defects in the corticalis which may be called primary. In enchondromatosis the cartilaginous foci which grow appositionally at their epiphyseal end, do not, however, maintain their regular longitudinal shape but grow furthermore expansively in all directions producing tumors which breaking down the bone tissue give rise to secondary cortical defects. Fig. 9 a shows schematically two enchondromata of which the right one is assumed to have originated in the central parts of the epiphyseal plate, the left one in its peripheral parts. Fig. 9 b shows the same enchondromata in a later stage of development. The left enchondroma here apparently primarily sets out from the periosteum because its appositional growth zone has been displaced from the epiphyseal plate to the surface of the bone (cf. fig. 6, Ollier's disease). This explanation of the mechanism of development of the enchondromata is supported by the *histological picture published by SPEISER*.

It is probable that cartilaginous tumors may also develop in a way different from that described above; but we have reason to count with the same primary production mechanism for the cartilaginous foci in systematized enchondromatosis and in Ollier's disease.

### Achondroplasia.

(Chondrodystrophia foetalis)

The genesis of the pathological-anatomical changes in achondroplasia have been subject to the interest of numerous authors. This is particularly the case in regard to the so-called *periosteal streak* which has been established in the epiphyseal cartilages in this disease. The problem of the genesis of the periosteal streak must be considered largely elucidated by M. B. SCHMIDT (1910) and A. DIETRICH. The periosteal streaks are cartilage canals whose connective tissue layers have adopted a periosteal character. This connective tissue may here give rise to bone formation of periosteal character within the epiphyseal plate instead of constituting, as normally, a base tissue for the cartilage formation (DIETRICH).

It is interesting to examine the well-known pathological-anatomical picture in achondroplasia in the light of the viewpoints which have been expressed above on the bone growth. The classical discovery of RANVIER, that the undifferentiated cell

elements within the epiphyseal cartilage constitute the base material for the osteogenic layer of the periosteum after the early embryonic period of development, throws light also on the periosteal streak in achondroplasia.

The cartilaginous exostoses may be presumed to arise through a disturbance in the differentiation of the undifferentiated layer of the epiphyseal plate. This disturbance seems to manifest itself by portions of the said connective tissue layer, when being displaced past the epiphyseal-periosteal limit to the surface of the bone, maintaining their chondrogenic qualities. In achondroplasia the conditions seem to be the opposite. Here the osteogenic layer of the periosteum runs in the shape of the so-called periosteal streak far into the inner parts of the epiphyseal plate. Evidently it is also here the question of a disturbance in the differentiation of the connective tissue of the cartilage canals. Obviously *in a too early stage in its displacement towards the periphery of the epiphyseal plate the connective tissue adopts the character of a tissue resembling that of the osteogenic layer of the periosteum.*

### Rickets.

Disturbances in the enchondral ossification in the metaphyses are of great importance for the constitution of pathological changes in rickets. These changes have been subject to thorough histological investigations by SCHMORL, M. B. SCHMIDT, PARK etc. In rickets the resorption of the cartilage cells of the epiphyseal plate is delayed, and the cartilage zone is abnormally broad. We know that in the undifferentiated layer of the epiphyseal plate there is normally a cell proliferation in different directions. The proliferation directed towards the periphery is of special importance. The signs of this proliferation directed towards the surface of the bone are easily overlooked in the normal histological picture. We have reasons, however, to expect that the delayed ossification processes in rickets may let this proliferation process appear in accentuated form. In the light of the above views it is interesting to study the literature on the histology of the abnormally broad epiphyseal plate occurring in rachitic bones.

Regarding the changes at the bone-cartilage limits in the costae in rickets M. B. SCHMIDT writes in 1929: "The completely normal picture of the ossification zone is thus here present, only a too large layer of excessive cartilage develops over it." — "In the

microscopic picture the excessive cell columns deviate towards the bone away from each other, occasionally they stand at right angles to the longitudinal axis vertically to the perichondrium, in places they only bend laterally . . ." — "... the cartilage may to some extent cover the surface of the bone; the intruding angle between the bone and the cartilage on the surface may be filled by dense white tissue penetrating like a white wedge into the interior."

The investigations by M. B. SCHMIDT (1929) and PARK have undoubtedly shown that distinct traces of a cell proliferation directed towards the periphery and the surface of the bone may be found in the epiphyseal cartilages in rickets. These phenomena have by the above authors been considered as secondary results of mechanical pressure on the abnormally developed cartilage zone. However, the histogenesis in the periphery of the normal epiphyseal cartilage shows certain characteristics which have been stressed by RANVIER, CAREY and POLICARD and which generally seem not to have been considered by authors dealing with the pathology of bone growth. It is evident that mechanical factors greatly influence the production of deformities in rickets. A closer comparison with the normal histogenesis in the periphery of the epiphyseal cartilage, however, may explain some of the characteristic changes in this zone typical of rickets.

### Summary.

Roentgenological investigations of two cases of *Ollier's disease* (chondrodysplasia) described in a previous paper confirm the opinion that the cartilaginous foci in this disease grow through limited portions of the epiphyseal plates forming a cartilage which persists, and is not replaced by bone. The appositional growth zone of a focus is displaced, however, during growth towards the periphery of the epiphyseal plate and finally out to the surface of the bone (fig. 6). — *The osteogenic layer of the periosteum of the normal bone grows in length by means of an undifferentiated cellular material which successively is displaced from the interior of the epiphyseal plate.* This normal process, the existence of which seemed probable on the basis of the investigations of Ollier's disease, has been described by RANVIER in 1889. Ollier's disease, nearly related to enchondromatosis, may be compared to an

experiment by nature with groups of "marked cells", which only partly follow the laws of normal differentiation, growth and resorption.

The normal process of development at the epiphyseal-periosteal limit which in general has remained unnoticed in pathology, may be of great importance in the pathogenesis of diseases of the growing skeleton. *Multiple cartilaginous exostoses* presumably arise in the following way: Limited portions of the undifferentiated connective tissue layer which is displaced by growth from the inner parts of the epiphyseal cartilage to the surface of the bone, do not as would be normal give rise to cells of osteoblastic nature. These portions of connective tissue continue to give rise to chondroblasts and cartilage, which is replaced by enchondral bone. Owing to this local disturbance of the differentiation no osteogenic layer is formed in these places and the processes which are dependent on such a layer fail to occur, viz. formation of periosteal bone and tubulation and modelling of bone (fig. 7). — The normal process of development explains the development of *enchondromata* which appear to originate in the periosteum. — The appearance of the "periosteal streaks" in *achondroplasia* may be explained in the following way: In a too early stage the connective tissue of the epiphyseal plate adopts the character of a tissue resembling that of the osteogenic layer of the periosteum. — In *rickets* evident traces of a cell proliferation directed towards the surface of the bone are found in the epiphyseal cartilages.

### Zusammenfassung.

Röntgenologische Untersuchungen an zwei in einer früheren Arbeit beschriebenen Fällen von *Ollier'scher Krankheit* (Chondrodysplasie) bestätigen die Ansicht, dass die Knorpelherde bei dieser Krankheit dadurch wachsen, dass umgrenzte Gebiete der Epiphysenscheiben einen Knorpel bilden, der bestehen bleibt und nicht durch Knochengewebe ersetzt wird. Die Appositionszone eines Herdes verschiebt sich während des Wachstums jedoch gegen die Peripherie der Epiphysenscheibe und schliesslich bis an die Oberfläche des Knochens (Abb. 6). — *Das Längenwachstum der osteogenen Schicht des Periosts des normalen Knochens geschieht durch undifferentiertes Zellmaterial, das nach und nach aus dem Inneren der Epiphysenscheibe veragert wird.* Dieser normale



Vorgang, dessen Vorhandensein durch die Untersuchungen der Ollier'schen Krankheit wahrscheinlich gemacht wurde, ist im Jahre 1889 von RANVIER beschrieben worden. Die mit der Enchondromatose nahe verwandte Ollier'sche Krankheit kann als ein Experiment der Natur bezeichnet werden mit Gruppen von »gemarkten Zellen«, die den Gesetzen der normalen Differenzierung, des Wachstums und der Resorption nur teilweise folgen.

Der normale Entwicklungsvorgang an der Epiphysen-Periostgrenze, der in der Pathologie im allgemeinen unbeachtet geblieben ist, dürfte für die Pathogenese von Krankheiten des wachsenden Skeletts von grosser Bedeutung sein. *Multiple kartilaginäre Exostosen* entstehen wahrscheinlich in folgender Weise: Begrenzte Gebiete der undifferenzierten Bindegewebsschicht, die durch das Wachstum aus den inneren Partien des Epiphysenknorpels an die Oberfläche des Knochens verlagert wird, ergeben nicht in normaler Weise Zellen osteoblastischer Natur. Diese Partien von Bindegewebe erzeugen nach wie vor Chondroblasten und Knorpel, der durch enchondrales Knochengewebe ersetzt wird. Durch diese lokale Störung der Differenzierung wird an diesen Stellen keine osteogene Schicht gebildet, und die von solch einer Schicht abhängenden Vorgänge, also die Bildung von periostalem Knochen und die Tubulation und Modellierung des Knochens, bleiben aus (Abb. 7). — Der normale Entwicklungsvorgang erklärt das Entstehen von *Enchondromen*, die vom Periost auszugehen scheinen. — Das Auftreten von »Perioststreifen« bei *Achondroplasie* lässt sich folgendermassen erklären: Auf allzu frühem Stadium nimmt das Bindegewebe der Epiphysenseibe den Charakter eines an die osteogene Schicht des Periosts erinnernden Gewebes an. — Bei *Rachitis* findet man im Epiphysenknorpel deutliche Spuren einer gegen die Knochenoberfläche gerichteten Zellwucherung.

### Résumé.

Les examens radiologiques de deux cas de *Maladie d'Ollier* (enchondrodysplasie) décrits dans un article antérieur confirment l'idée que dans cette affection les foyers cartilagineux croissent au travers de portions limitées des plaques épiphysaires et forment un cartilage qui persiste et n'est pas remplacé par de l'os. Cependant la zone de croissance par apposition d'un foyer se déplace, à mesure que le sujet grandit, vers la périphérie du cartilage de conjugaison et finit par émerger de la surface de l'os (fig. 6). —

*La couche ostéogénique du périoste de l'os normal croît en longueur grâce à un tissu cellulaire indifférencié qui est repoussé successivement de l'intérieur de la plaque épiphysaire.* Ce processus normal, dont l'existence semble probable si l'on se base sur les recherches consacrées à la maladie d'Ollier, a été décrit par RANVIER en 1889. La maladie d'Ollier, étroitement apparentée à l'enchondromatose, peut être comparé à une expérience que la Nature fait avec des groupes de «cellules marquées» qui n'obéissent que partiellement aux lois de la différenciation, la croissance et la résorption normale.

Le processus normal de développement à la frontière entre l'épiphyse et le périoste, qui en général a passé inaperçu en pathologie, peut avoir une grande importance pour expliquer la pathogénie des affections du squelette au stade de croissance. *Les exostoses cartilagineuses multiples* doivent probablement se produire de la façon suivante: Des portions limitées de la couche de tissu conjonctif indifférencié qui par la croissance est déplacée de l'intérieur du cartilage épiphysaire vers la surface de l'os, ne donnent pas lieu, comme il serait normal qu'elles le fissent, à l'apparition de cellules du type des ostéoblastes. Ces endroits du tissu conjonctif continuent à produire des chondroblastes et du cartilage, qui est remplacé par de l'os enchondral. Du fait de ce trouble local de la différenciation il ne se forme pas de couche ostéogénique à ces endroits, et les processus qui dépendent d'une couche de ce genre manquent à se dérouler, à savoir la formation d'os périostique, sa tubulation et son modelage (fig. 7). — Le processus normal du développement explique la production d'*enchondromes* qui paraissent avoir leur origine dans le périoste. — L'apparition des «stries périostiques» dans l'*achondroplasie* peut être expliquée comme suit: A un stade trop précoce le tissu conjonctif de la plaque épiphysaire adopte le caractère d'un tissu ressemblant à celui de la couche ostéogénique du périoste. — Dans le *rachitisme* on trouve des traces évidentes d'une prolifération cellulaire dirigée vers la surface de l'os dans les cartilages épiphysaires.

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## A Contribution to the Knowledge of Primary True Concrements in the Small Bowel.

By

STEN GRETTE.

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Illnesses caused by concrements in the stomach and the gut of humans are rare. In some cases the concrements have been formed in other organs and have entered the gut secondarily, where they have given symptoms of foreign bodies. In other instances they have been formed primarily in the digestive tract.

Of the concrements secondarily appearing in the bowel, without doubt gall-stones are the most common. Only in exceptional cases have concrements from the urinary tract entered the bowel through pathological uro-intestinal fistulas. Most of the stones coming from the biliary tract pass the common bile duct and are seldom of such size as to cause any clinical symptoms during their passage through the intestines. At times gall-stones enter the bowel through internal pathological biliary fistulas. Biliary concrements which have entered the small bowel in this manner can be of such size as to cause an intestinal obstruction. Among sicknesses caused by concrements in the bowel, ileus caused by gall-stones is, in spite of its relative scarcity, the one most commonly seen by surgeons.

The building material of the concrements which are primarily formed in the gastro-intestinal tract is made up of substances of alimentary origin and the material from their break-down, of secretions from the digestive glands and of the remains of bacteria. A *true* concrement can be formed through the precipita-

tion and deposit of substances which are found in the chymus under normal alimentary conditions. However, much more common in the digestive tract are *false* concretions which have generally been formed owing to special alimentary conditions. The latter type can be caused by 1) a clumping together of large amounts of ingesta which are hard to digest or are indigestible, 2) a precipitation of substances which are insoluble in water and in the digestive juices because of a resorption of their solvents, 3) a sedimentation and sintering of suspended insoluble salts, or 4) a simple inspissation of the intestinal content.

Through clumping, baking and impregnating with mucus, threadlike particles which have been ingested and which are hard to digest or are indigestible can form false concretions, the so-called bezoars. These concretions which are formed of hairs (trichobezoars) or vegetable fibers (phytobezoars) usually develop in the stomach. Another type of alimentary concretion is the varnish stone found in those who drink varnish. As a rule these are also formed in the stomach by precipitation due to the resorption of the alcoholic solvent. A third group of concretions caused by special substances, usually taken by mouth for medicinal purposes, are the rare stones formed from salol, magnesia, barium sulphate, chalk and lime. In these instances the concretions have been created through a sedimentation and sintering of the insoluble but suspended substance. Now and then in persons with a marked obstipation concretion-like formations are found in the colon — the so-called fecaloma — caused by simple inspissation of the feces.

As far as the formation of true concretions, enteroliths, is concerned, there is no evident relation between them and the type of ingesta. As a rule such chemically pure concretions as those which are found in the urinary and biliary tracts are not formed in the digestive tract. Besides precipitated chemical substances, many dead and even living bacteria plus larger or smaller quantities of organic corpuscular contaminations of alimentary origin make up the enteroliths. A concretion can be formed around a food particle which is more or less hard to digest or around a foreign body. However, more often it is formed without any definite nucleus. Even such false concretions as bezoars can become encrusted through the precipitation of concretion-forming substances. From a theoretical point of view, it is therefore impossible to separate distinctly between, on one hand, true concretions

which have formed around indigestible food particles or which are markedly contaminated by particles hard to digest and, on the other hand, false concretions which are encrusted or covered on the surface with concretion-forming substances. However, the concretions which have been found have, as a rule, been so definitely characteristic of either false or true concretions that for practical reasons this distinction has been well motivated.

Of the concretions which primarily have been formed in the digestive tract, the majority have been found in the colon or the stomach. Stones in the small bowel are very rare. In their large monography, "Die Fremdkörper des Magen-Darmkanals des Menschen", WÖLFLE and LIEBLEIN could find only twelve cases of concretions in the small bowel which had been reported in the literature up to 1909. After that time a few more rare cases of both false and true concretions have been reported. In some of the cases, especially from earlier years, information is missing regarding, among other things, the chemical composition which makes their definite classification impossible.

The finding of varnish stones in the small bowel has been published by FRIEDLÄNDER (1881), HALLAS (1914), BELLMANN (1919) and RAAGAARD (1937). Bezoars have been reported among others by MARCHAND (1894), HART (1923) who has published 8 cases, and by HARGRAVE and HARGRAVE (1936). Bezoars and varnish stones which have been found in the small bowel have been formed most likely in the stomach and have secondarily progressed to the gut. As a rule the symptoms have been those of an acute ileus. In 1888 TREVES reported a case in which the small bowel was obturated by a magnesia concretion.

In connection with an observed case, in my continued discussion I shall dwell mainly upon the subject of true concretions of the small bowel.

The true small bowel concretions which have been found have been of varying chemical composition but, according to BLIX (1935), they can be grouped into three different, distinct types depending upon their main chemical component: 1) Stones of ammonium-magnesium phosphate, calcium phosphate and calcium carbonate; 2) Concretions formed mainly of calcium oxalate; 3) Stones of which the main components is choleic acid. As representing a fourth type of true small bowel concretions

one may possibly consider a stone found by PHILLIPS (1920/1921). This was made up mainly of hydroxy fatty acids, partially free and partially as glycerides and anhydrides.

Enteroliths, composed mainly of mineral salts, have been found most often in the colon but have been seen now and then also in the lower part of the small bowel — WALDRAFF (1902), WIMMER (1905, 1907), GRAEVE (1909/1910) — or in a Meckel's diverticulum — GREVILLIUS (1940).

Only two cases of calcium oxalate stones are known and they have been published by BARTH (1928) and BLIX (1935).

In 1908 BERG found in the small gut enteroliths which were analyzed chemically by Sjöqvist (1908) who found them to consist mainly of choleic acid. The next choleic acid enterolith was observed by PHILLIPS (1920/1921) and analyzed by RAPER (1921). Eight more cases of the same type of stone from the small gut have been published later, all in Sweden. MÖRNER (1923, 1927, 1930, 1937 and 1939) himself has collected five cases and besides has analyzed chemically two cases operated on and reported by HELLSTRÖM (1929). Finally, the last-mentioned author published still another case in 1936. The eleventh case of choleic acid enterolith is hereby reported by the author.

Journ. No. 2872/44. The patient is a farmer's wife, aged 51, who during the last 20 years has had periodic attacks of uncharacteristic dyspepsia and several attacks of abdominal pain which physicians considered to be attacks of gallstones. A few weeks before coming to the hospital the patient had had stomach upsets after meals but no vomiting; now and then also prolonged stabbing ache with a troublesome obstipation. The last few days accentuation of the mentioned symptoms and 7—8 hours previous to admission to the hospital suddenly worse following an enema without results. Got severe, continuous pain in the whole of the abdomen, "became very ill and was about to faint". Was gradually a little less affected but the pains continued. Repeated spells of vomiting and rising temperature.

*Physical examination:* Ill. Temperature 39.4° C. Pulse 120 per minute. The abdomen somewhat distended, boardlike rigidity, marked tenderness, no definite liver dullness. X-ray shows plenty of free gas and fluid in the abdomen.

*Operation* (The author): Laparotomy with exposure of the bowel. Midline incision above the umbilicus. Diffuse peritonitis with much cloudy, yellowish-brown, fibrinous fluid and gas in the abdomen. About two meters below the duodeno-jejunal flexure the small bowel shows a swelling about the size of a hen's egg. To the right of the midline and at the height of the navel this part of the gut is fixed lightly to the posterior abdominal wall by fibrinous adhesions. It shows for

more than half of its circumference a totally gangrenous wall with a perforation of the size of a shilling through which is seen a yellowish-brown concrement. Especially near the swelling, the bowel shows areas of ecchymosis and rather heavy fibrin deposits. Above the concrement it is rather thick-walled, edematous and wide but collapsed. Below the stone, the bowel is much narrower but not markedly contracted and shows changes due to the diffuse peritonitis. Concrements are palpable in the gall-bladder. Wide adhesions are found between it and the duodenum. Because of this it is suspected that the concrement in the bowel is a migrated gall-stone. The definitely gangrenous changes prohibit enterolithotomy and suturing. Because of the peritonitis and the poor condition of the patient a bowel resection is doomed not to succeed. The gangrenous loop of the bowel is therefore brought forward and placed on the abdominal wall after which the concrement is expressed through the perforation.

The concrement (Fig. 1) corresponded in shape and size to an ordinary hen's egg, and weighed about 40 g. The slightly roughened surface was of a yellowish-brown color. The broken surface was definitely layered. In the outer layer the consistence was hard and stone-like, in the center softer and somewhat marrowish. After splitting, the concrement gave off a nasty stench. No macroscopic nucleus could be observed.

The patient died from the peritonitis already eight hours after the operation.

*An autopsy* showed a serofibrinous, purulent peritonitis. The gall-bladder contained 15 stones of cholesterine and pigment. The broad adhesions between the gall-bladder and the duodenum could be broken easily. There was no cholecysto-duodenal fistula or scar as evidence of an earlier one. The bile ducts were of normal width and free. During the routine examination of the bowel, no diverticulae were found. However, about two meters above the ileocecal valve there was a moderate, well localized constriction of the ileum, which easily would admit a finger and which was rather elastic. It was caused by a small fold a few mm high protruding into the lumen, which in a circular fashion surrounded the whole lumen of the bowel. The constriction which macroscopically looked like a healed end to end anastomosis of the bowel, could not be seen on the surface. A microscopic examination did not give any reason to believe that the constriction might be due to a tuberculous or non-specific scar. The muscularis propria did not take part in the formation of the fold, which mainly consisted of an excess of submucous connective tissue and a very markedly developed muscularis mucosae. The mucosa was normal. Considering the localization these observations most likely point to an alteration of a congenital origin and to the fact that the change probably had had some connection with the ductus omphaloentericus or its formation. The microscopic picture further suggests that the observed constriction of the lumen hardly could have constituted a real hindrance for the passage through the gut.

Thus the autopsy proved that the concrement was not a migrated



gall-stone. Because of this it must be considered as a stone which primarily had been formed in the bowel.

A thorough chemical analysis of the concrement has been made by Professor G. BLIX who, in an addition to this article, gives a report of the findings.

*The conditions for the formation of true concretions in the bowel* are only incompletely known. As in the formation of stones in the urinary and biliary tracts, chemical factors — such as the concentration of concrement-forming substances and their degree of solubility — and mechano-physical factors — especially the rate of flow of the chymus — have been considered important in the formation of concretions in the bowel.

First I shall discuss the connection between *chemical factors* and the formation of concretions. The primary condition for this is that a dissolved substance from a higher level of the bowel passes into — or is synthesized in — a chemical surrounding where it is poorly soluble or insoluble and therefore is precipitated. There is always plenty of water in the content of the bowel. Because of this water-soluble substances cannot take part in the formation of concretions. This also applies to such poorly soluble substances which through the enzymes of the digestive juices can become easily soluble in water. Only indigestible or insoluble substances or such substances as are water-soluble only under certain conditions can therefore form concretions. In this connection the acidity of the chymus is a deciding factor. The importance of the acidity for the formation of concretions was brought out by SCHUBERG already in 1882 and later by WÖLFLE and LIEBLEIN (1909), MÖRNER (1923—1939), HELLSTRÖM (1929) and BLIX (1935).

The acidity of the content of the small bowel has been studied partially on the flow from bowel fistulas and partially on chymus collected through an intestinal tube. EWALD (1879) found the reaction of the bowel content from a fistula, probably located low down in the small bowel, to be acid or neutral but never alkaline. In chymus from fistulas in the lowest portion of the small bowel, MACFADYEN, NENCKI and SIEBER (1891), as well as LIEBLEIN (1909) usually found an acid reaction, BICKEL and KANITZ (1934) a pH varying between 8.7 and 9.1. In 182 determinations on the bowel content from a duodenal fistula, HUME, DENIS, SILVERMANN and IRWIN (1924) obtained pH values varying between 5.9 and 8.23, with an average of 7.02. The most complete

determinations of the acidity of the small bowel content, collected through a gastrointestinal tube, seem to have been made by VAN DER REIS and SCHEMBRA (1924). These investigators give the following averages from their determinations of the fasting acidity of the small bowel content: upper small gut pH 6.287, middle portion pH 6.46 and lower part pH 6.792. They point out that the juice from the small bowel is relatively well buffered and that the reaction is affected very little, and then only in the upper ileum, by the acidity of the stomach. According to VAN DER REIS (1925) temporarily the content of the small bowel becomes more acid during the passage of the food but its reaction returns very quickly to the fasting level. During the investigation of the acidity of the small bowel content, collected through an intestinal tube, other authors have found values which have deviated from those given by VAN DER REIS and SCHEMBRA. Thus on two persons used for experiments, McCLENDON, BISSELL, LOWE and MEYER (1920) measured pH values varying between 4.1 and 6.5. Even by these authors the weakest acidity was found to be in the lower portion of the small bowel. BOGENDÖRFER (1924) gives values which are often slightly on the alkaline side.

Different methods, as well as individual variations in the subjects, can be the cause for the varying acidity values given by the different authors. However, in general the figures show that the acid stomach content already in the upper portion of the small bowel greatly loses its acidity and that thereafter the hydrogenion concentration of the chymus gradually decreases during its downward passage. In the most caudal portion of the small bowel, the content can still be acid but also mildly alkaline. Most likely within certain limits there are individual variations of the acidity of the small bowel content. It may also be supposed that in the same person in a certain bowel segment, depending upon purely endogenous factors, the acidity can be somewhat different during different periods of time. Secretory disturbances of the mucosa during inflammations and pathological changes of the bacterial flora caused by difficulties of the passage in all probability also influence the degree of acidity of the small bowel content. BOGENDÖRFER and BUCKHOLZ (1924) think that they have found that a diet high in protein changes the reaction of the small bowel content to the acid side and that a pure carbohydrate diet changes it in the alkaline direction. According to VAN DER

REIS (1925), however, changes in the general alimentary method of living have no definite effect upon the reaction of the small bowel content.

The main components of the mineral stones — ammonium-magnesium phosphate, calcium phosphate and calcium carbonate — are dissolved in water if the reaction is acid but are precipitated if it is alkaline. Thus a necessary condition for the formation of these concrements is an alkaline or at least a neutral reaction, a fact which already SCHUBERG (1882) and later several other authors have stated. It is therefore natural that the few concrements of this type which have been found in the small bowel only have been seen in its lower portion where the reaction can be alkaline, never in its upper portion. As far as can be determined from the descriptions, the most orally located stones have been found by GREVILLIUS (1940) in a Meckel's diverticulum. Sufficient building material is present in soluble form already during normal alimentary living conditions. Thus a rich supply of such substances in the food is not necessary but may be considered as favouring the formation of concrements or at least as speeding the rate of deposit.

Free choleic acid is the main component of choleic acid stones. In the human bile there is no free choleic acid but it has been supposed to be present in minute quantities combined as glycocholeic acid, which should be found as a sodium salt. (According to recent investigations native bile contains no combined choleic acids — SOBOTKA (1938).) Sjöqvist (1908) considered the free choleic acid of the concrements as a breaking down product of glycocholeic acid. Because of its presence in such small quantities, he seems to have been prone to accept an abnormally high content of glycocholeic acid in the bile as a condition for the concrement formation. Even RAPER (1921) considered the glycocholeic acid as the material of origin and that, at the time of the formation of stones, primarily this acid is precipitated and then secondarily free choleic acid is formed through the breaking down of the glycocholeic acid through the action of bacteria. WIELAND and SORGE (1916) explained the chemical nature of the choleic acid and showed that it is a combination of desoxycholic acid and higher fatty acids in the molecular proportions 8: 1. HELLSTRÖM (1929) considers a strong increase of the choleic acid in the bowel as an important condition for the formation of stones. This he believes could be caused by an abnormally in-

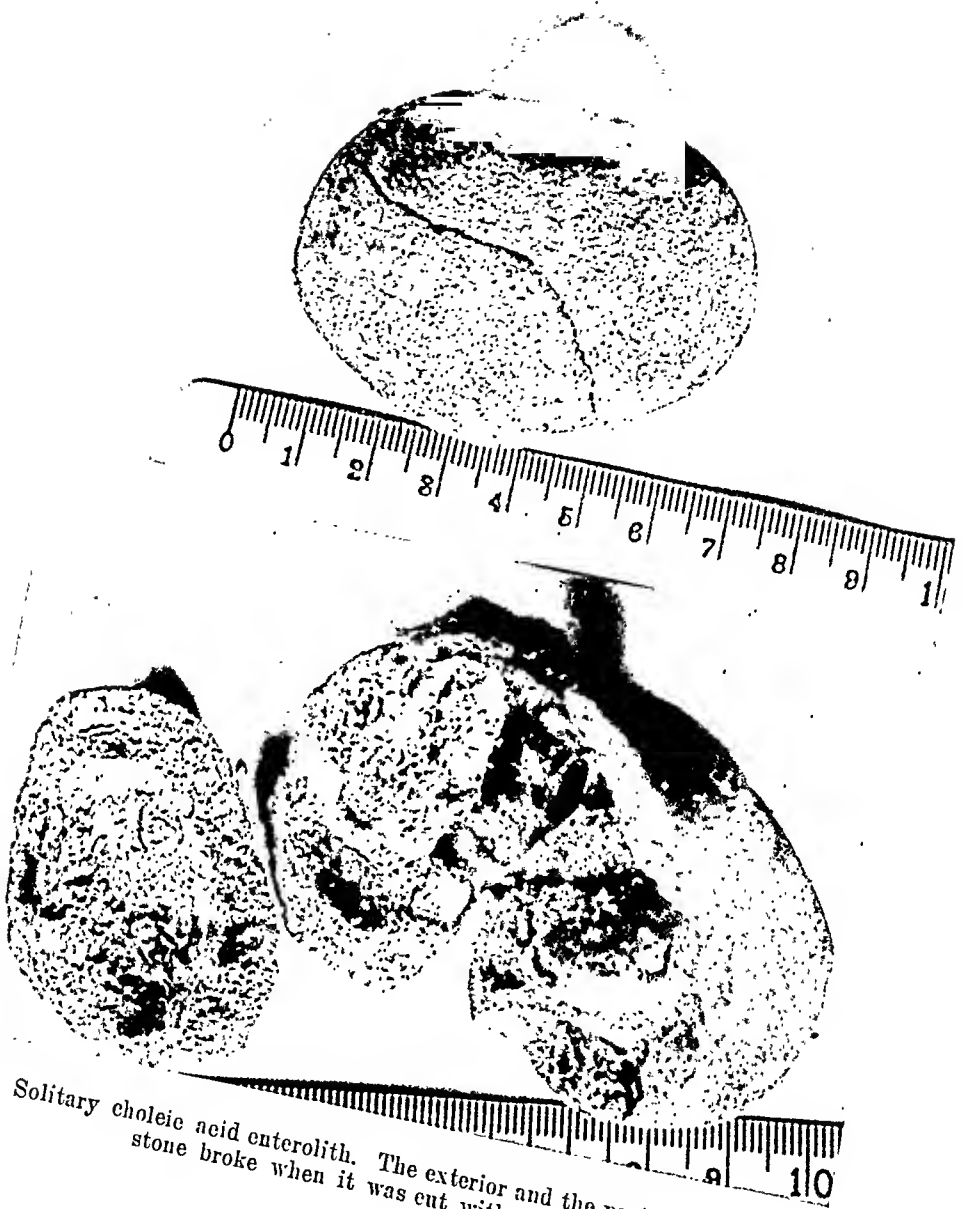


Fig. 1. Solitary choleic acid enterolith. The exterior and the parts into which the stone broke when it was cut with a knife.

GRETVE: Primary True Concrements.



creased secretion in the bile of the sodium salts of the glyco-choleic acid but, besides, he considers also the possibility that an increased concentration of the choleic acid, at least partly, could depend upon a synthesis in the bowel by the addition of higher free fatty acids to desoxycholic acid. MÖRNER (1927) points out that an acid reaction of the content of the bowel is a necessary condition for the formation of the choleic acid enteroliths because the choleic acid is present in them as a free acid. BLIX (1935) has made a close study of the chemical conditions for the formation of the choleic acid stones. He considers that the choleic acid in the concrements to its greatest part has been formed in the gut, and for the following reasons. In such a slightly acid condition as prevails in the small bowel, only a very weak acid can be present as free in any quantity. Considering the values of the strengths of the various bile acids, as determined by JOSEPHSON (1933), it is evident that already at such a weak acid reaction as pH 6 the desoxycholic acid, which without doubt is the weakest bile acid, for its most part is present as a free acid. However, because of the degree of acidity which is present in the bowel, other bile acids can be present as free acids only in relatively small quantities. Free desoxycholic acid combines relatively easily with free higher fatty acids, which are as a rule supplied in large quantities by the food. Therefore it seems to BLIX that desoxycholic acid shall be found in the bowel "exclusively in the form of choleic acid". Without considering an abnormal composition of the bile, when the reaction of the bowel content is acid there are always the chemical conditions for a rich supply of building material for this type of enterolith.

In order to serve as concrement builders, the materials discussed above have required either an alkaline or acid reaction at the site of the stone formation. Other substances found in the enteroliths are difficult to dissolve in water both at the degree of acidity and that of alkalinity which is present in the intestinal tract. It is possible to imagine that such components have been brought to the concrement because larger particles suspended in the food have adhered to the surface of the growing stone — thus a form of false concrement formation. However, as a rule even in the question of these substances one must consider a true concrement formation in that the concrement-forming substance has been synthesized in the bowel and deposited on the concrement. Among substances of this nature is calcium oxalate which in two

described stones has been of such quantity that it has been the main part of the enteroliths. In several other examined true small bowel stones a smaller quantity of calcium oxalate has been demonstrated. The building material consists most likely of the oxalic acid in the food which in the bowel is combined with the calcium which probably always is present in excess. The amount of calcium oxalate in a concrement is therefore most likely to a certain extent an indication of the amount of oxalic acid which is present in the ingesta. Quite often also the poorly soluble zinc sulphide has been found in enteroliths, usually only as traces but at times in considerable quantities. In this connection, BLIX (1935) points out that zinc is a substance which is present in relatively great abundance in the organism and that the hydrogen sulphide probably has been formed in the bowel through bacterial splitting of the proteins. Even other metals such as magnesium and iron have now and then been demonstrated in small amounts in enteroliths. Some stones contained traces of bilirubin and cholesterol. Fatty acids, partially free, partially as glycerides and anhydrides have been found in true bowel concrements. The quantity of these has usually been relatively small, at other times rather marked, in one case, described by PHILLIPS (1920/1921) even the main constituent of the concrement. Whether the fatty acids are to be considered as real concrement building materials or to be regarded more as contaminants can be discussed.

From what has been said above, it is seen that the chemical composition of the enterolith indicates the approximate acidity which prevailed at the site of formation and thereby it can be determined roughly at which level of the bowel the concrement was formed.

The cut surface of enteroliths shows as a rule a more or less marked, usually concentric layering. The reason for the layering is most likely that during different periods of the concrement formation, the chemical surroundings have varied. The rate of the depositing can have varied because of changing concentration of the concrement forming substances in the chymus. Furthermore, depending upon smaller variations of the acidity at the site of the formation, a retardation or acceleration of the precipitation, perhaps even a temporary decomposition of the surface layer of the stone, is possible. As a rule, however, the enteroliths have quite a uniform chemical composition showing that during its

whole formation a concrement is usually located primarily in a uniform chemical environment and therefore probably in the same place in the bowel. Stones can have a construction, however, which plainly shows that the chemical environment has varied considerably during its time of formation. Thus, in one case MÖRNER (1930) found choleic acid stones which were surrounded by a thin outer layer of calcium carbonate and calcium phosphate. As MÖRNER contends, probably the stones in this case had been formed in the upper portion of the small bowel and after that had migrated to the lower portion of the small gut where in the alkaline surroundings mineral salts had been deposited on the surfaces of the concrements.

The true small bowel concrements are not at all chemically pure, as has been mentioned already in the introduction. Excluding pips and incompletely digested chunks of food, which not so seldom form a central core of the enteroliths, these contain regularly more or less of smaller corpuscular, indigestible particles from the food. The particles have adhered to the stone and become baked into the same during the continued depositing. As HELLSTRÖM (1929) showed, a special form of contamination is made up of dead and living bacteria which are present to a great extent in the concrement. No doubt a factor to be taken into consideration in the explanation of the layering of the concrements is the relation between the supply of contaminating particles and the rate of precipitation of concrement-forming substances.

From the preceding discussion it is clear that the chemical conditions are always present for the formation of a true concrement, even if they are probably more or less favourable. The formation of stones, however, takes place only in exceptional cases wherefore one must conclude that other factors than chemical ones are decisive as to whether a concrement will form. Closest at hand to consider as cause of the formation of enteroliths are *mechano-physical factors*, the importance of which is plain and generally accepted in the formation of stones in the urinary tract.

One of the questions which first presents itself is whether a concrement can form and thereafter grow to the size it usually has when it is found in the free lumen of a normal small bowel. Should it not have been washed away by the peristalsis before it reached any size of importance? The experience concerning the behavior of foreign bodies in the intestinal tract teaches that



such smaller rounded ones independent of their other physical properties usually in a short time pass through a normal digestive tract. In relation to the width of the bowel lumen, relatively large objects require for their passage through the bowel often a longer time which, however, as a rule does not exceed a few weeks. Not seldom do they cause one or more delays giving symptoms of obstruction of short duration. Foreign bodies which are too large to pass through the small bowel cause as a rule in a short time a definite ileus. Most likely the true bowel concretions have no special physical or other properties which make them behave in the free lumen of the gut markedly different from foreign bodies. Their usually smooth surface and rounded form as well as, for some concretions, the low specific gravity may possibly make their carrying by the peristalsis more difficult. Through such properties the movement in the bowel can at the most be delayed but probably not prevented. The passage of a bowel concretion per vias naturales has also been observed now and then. In such a case HELLSTRÖM (1936) had an opportunity to follow by means of repeated X-ray studies the passage of a chestnut-sized choleic acid enterolith. The concretion caused two attacks of ileus. The first was treated by doing a Witzel's fistula, the second a good month later, subsided spontaneously by the passage of the concretion. The reason for the retention of a stone in the bowel must most likely be looked for somewhere else than in the enterolith itself.

Several of the enteroliths described in the literature contained in the center a food particle hard to digest, most often the stone of a plum. Some of the bezoars found in the small bowel have been encrusted or covered on the surfaces with concretion-forming substances. KOBAYASHI (1935) and SCHEID (1937) described the small bowel concretions formed by the incrustation of compresses which have been forgotten in the abdominal cavity at the time of an operation and which secondarily penetrated into the bowel. Observations such as the above show plainly that concretion formation is favoured if the precipitation can take place around a body which is hard to digest or is indigestible. However, enteroliths without a definite core are more common than those with one, which shows that a nucleus forming foreign body is not a necessary condition for the formation of a stone. Only if the body is of such size as to require a marked time for its passage but not sufficiently large to cause a definite ileus, is

it possible that it alone is sufficient to cause a concrement formation. Such a method of formation is possible for the shell-formed choleic acid enterolith described by MÖRNER (1937). Smaller bodies, which are usually found as the nucleus of an enterolith, are most likely passed by a normal bowel before they have had time to be the seat of any concrement depositing. One must be satisfied with the statement that the formation of an enterolith often starts around a formed body but that the main condition for the same — the retention of the developing concrement — must be looked for elsewhere and that probably in the bowel itself.

From various sources it has been claimed that a retarded passage of the chymus through the small bowel is one factor which favours the formation of concretions. A retardation of the flow of the chymus as a whole can be caused by a failing motor activity of the musculature of the bowel or by organic changes such as peritoneal adhesions or by sclerosing processes in the bowel wall. An even more pronounced retardation of smaller portions of the bowel content can be expected in locally strongly dilated loops of the bowel — for instance in irreducible hernias, in front of stenoses — and in pathological diverticulae-like protrusions of the bowel.

Based on observations in actual cases, MÖRNER (1930) and HELLSTRÖM (1936) have claimed that enteroliths can be formed in diverticulae and from there secondarily invade the free gut. In MÖRNER's case several smaller choleic acid stones were found above a tuberculous stricture in the distal portion of the small bowel, as well as a score of diverticulae of the size of hazel nuts and walnuts in the uppermost meter of the jejunum. In HELLSTRÖM's case, just related in a different connection, during an X-ray study a short time after the operation was observed a slightly more than plum-sized diverticulum probably belonging to the duodenum. The solitary stone in HELLSTRÖM's case as well as all the concretions in MÖRNER's contained in their center stones of plums.

According to general experience, indigestible, formed bodies, which, as has been pointed out above, can favour the formation of concretions, are not seldom caught and retarded in diverticulae. Even the liquid bowel content can be retained in these for quite a while. FORSELL and KEY observed already in 1916 during X-ray examinations that after the contrast medium has passed through the free lumen of the bowel it remains a shorter or longer

time — even several days — in the duodenal diverticulæ. The tendency of these to retain formed bodies gives a plausible explanation why larger concretions can remain in the intestinal tract without forming a mechanical hindrance for the passage of the chymus.

If the theory is true which proposes that enteroliths found in the lumen of the small bowel have been formed in diverticulæ, then most likely cases should be found in which stones have remained in the diverticulæ. That is also the case. Colon enteroliths are reported often to have been found in diverticulum-like protrusions, and in the appendix true mineral stones are relatively common. WÖLFLE and LIEBLEIN (1909) studied five cases where concretions labelled as stones of the bowel or fecal stones, had been observed in a Meckel's diverticulum. Later enteroliths have been found there by HANKE (1933) and GREVILLIUS (1940). TERRY and MUGLER (1921) reported a case in which an enterolith, formed in a diverticulum of the jejunum of a woman 59 years of age, had caused an ileus. The concretion could be broken to pieces without the opening of the bowel and the fragments passed per vias naturales as "yellow shale". In 1924, WATSON found a walnut-sized enterolith in a diverticulum of the jejunum. No further information is given concerning the nature of the stones in these cases. Several authors report that bowel stones can be present in duodenal diverticulæ, one such case having been observed by CHOMEL. During an autopsy HARLEY (1856) observed in a duodenal diverticulum a rather large concretion which he considered to be a gall-stone. It is possible, however, that it could have been an enterolith.

However, in the cases where enteroliths have been found in the free lumen, the concomitant presence of diverticulæ has been reported only in the above mentioned two cases published by MÖRNER and HELLSTRÖM. Of the surviving cases, however, it seems that only HELLSTRÖM's patient has been examined by X-ray. In several patients who have died from the disease autopsy has been performed but diverticulæ have been found only in MÖRNER's cases. That does not mean, however, that such may not have been present. Since the attention has not been especially directed towards this problem, it is possible that observations of diverticulæ have not been reported, or that diverticulæ have been present but not observed during the autopsy. It has been reported by authors — ÅKERLUND (1918/1919), BERG (1930),

KÖHLER (1933) and others — who have dealt with studies of duodenal diverticulæ that not only during operations but also during post mortem examinations it has been difficult to locate diverticulæ which have been demonstrated by X-ray. To rule out with a fair degree of accuracy the presence of duodenal diverticulæ, it would require an X-ray study of the autopsy specimen after it had been filled under pressure with a contrast medium.

It is evident from these discussions that the mechanical possibilities for the concretum formation in the free lumen of the bowel are markedly unfavourable compared with those in diverticulæ of the gut. Therefore, if one is prone to accept the diverticular origin even for the enteroliths found in the free lumen of the bowel it remains to explain how the concretum after a long time leaves its stationary place of abode and starts wandering out into the bowel. Closest at hand is to suppose that in such cases the stone during its continued growth meets the least resistance for its expansion in the direction of the neck of the diverticulum and that this by and by dilates to such a size that the concretum can be delivered into the lumen of the bowel. This is especially a probable course for the duodenal diverticulæ which lie up against the relatively solid pancreas. During closer studies of the photography of one of the choleic acid stones which HELLSTRÖM (1929) depicts, it is observed that the outer layers are not complete but that they cover one of the poles of the enterolith in a cap-like manner. This observation speaks distinctly against the supposition that the stone during the later part of its formation should have been flooded with chymus in the free lumen of the bowel. On the contrary, it is a strong proof for the proposition that it has been formed in a diverticulum and from there secondarily migrated into the bowel. It is probable that the delivery has taken quite a long time and that the stone which has been wedged in the opening of the diverticulum has prevented choleic acid containing chymus from penetrating into the diverticulum while continued depositing could have taken place on the pole which protruded into the lumen of the bowel.

After the reasoning given above, without doubt to me the enteroliths found in the free lumen of the bowel could have had their origin in diverticulæ of the same. The question is then whether all enteroliths have a diverticular origin. If the cases of enteroliths which have been described in the literature are closely

studied, it is evident that on the whole they can be classified into two types: 1) those in which the symptoms have been caused by one solitary large, usually rounded or oval stone which has obturated the lumen of a small bowel which in other respects does not show any evidence of a hindered passage; 2) those in which have been found one or usually several rounded or irregular true concrements above strictures usually caused by tuberculosis, not seldom in dilatations of the small bowel caused by the pathological process.

It seems difficult for me to find any other explanation for the large, solitary enteroliths belonging to the first group than that they have had a diverticular origin. Only for the shell-covered enteroliths which have been formed around a large, hard to digest particle supplied by the ingesta the possibility is admitted that the stone formation could have taken place in the free lumen of the bowel. This type of concrement formation, represented by an enterolith described by MÖRNER (1937), most likely can be compared with that covering which can occur around bezoars or gallstones which are of such size that they are retained in the small bowel for a longer period of time. As for the concrements which have been found above a stricture of the bowel, the possibility also exists that they have been formed in diverticulae belonging to the upper portion of the small bowel from where they have migrated only to be stopped in front of the stricture. Even relatively small stones which should have passed through a normal intestinal tract without causing any symptoms can thus be retained. Most likely this is the mode of formation in the case reported by MÖRNER (1930) where choleic acid stones surrounded by a thin outer layer of calcium carbonate and calcium phosphate were found above a stenosed portion of the lower ileum. For the second type of stones the possibility also exists, however, that the formation of the concrement has taken place locally in front of the constriction. In the reported cases, the stenoses have been located in the lower ileum which is typical of tuberculosis. The concrements which have been found in some cases have been choleic acid enteroliths, in other instances stones of mineral salts, and once a calcium oxalate stone. As has been stated already, the most favourable chemical conditions for the formation of the first mentioned kind are to be found in the upper portion of the small bowel. However, the acidity can be high enough even in the distal portion of the small bowel to make possible

the formation there of choleic acid enteroliths. HELLSTRÖM (1929) points out that the formation of this kind of a concrement in the distal portion of the small bowel can be favoured because of a shift of the acidity towards the acid side through a bacterial breaking down of carbohydrates in the stagnated content of the bowel. Stones of mineral salts can be formed only in an alkaline surrounding wherefore one must suppose that they have been formed in the lower part of the small gut and then most likely just above the obstruction. In several of these cases, the concrements have been located in diverticulum-like protrusions of the bowel just above the stenosis — GRAEVE (1909/1910), BARTH (1928) — or in locally markedly dilated loops of the bowel. The retardation of the bowel content which must occur in such local dilatations in front of a stenosis without doubt favours the formation of concrements. Food particles hard to digest, such as pips etc., are easily stopped in front of a stenosis and can then serve as a nucleus for a concrement. Several of the enteroliths which have been found in front of a stenosis have had a pip in the center.

Summarizing the conditions for the formation of true small bowel concrements, the following can be said. The chemical conditions for the formation of enteroliths in the small bowel can be more or less favourable but as a rule they are present. The most important condition for stone formation is to be looked for among mechano-physical factors which enhance the retention of concrements in the stage of development and which favour the deposit of concrement-forming substances through the stagnation of the chymus. These conditions, so favourable for the enterolith formation, are present in diverticulae and in local dilatations of the small bowel in front of strictures. In such places the bowel content stagnates often. Besides, early concrement formations and indigestible particles, which can serve as a nucleus for concrement deposits, are here more prevented from being washed on further with the stream of chymus than in the free bowel. An indigestible particle which can serve as a nucleus is not necessary for the formation of a concrement but enhances the first deposit.

There is no fundamental difference between the formation of true small bowel stones of different chemical composition. This is only an indication of the chemical surroundings at the site of

formation. In the first place it is the acidity of the bowel content which here is the deciding factor of the qualitative composition of the enterolith. Certain substances such as calcium oxalate and zinc sulphide can be deposited on enteroliths whether the reaction be acid or alkaline. Others are concrement-forming only in an alkaline medium, *e. g.* calcium phosphate and ammonium-magnesium phosphate, or they can be deposited only in an acid reaction as is the choleic acid. As for the enteroliths formed in an acid surrounding as well as those built in an alkaline one, the internal quantitative relation between the components probably depends upon their concentration in the chymus and their degree of insolubility at the actual degree of acidity.

As far as the *clinical symptoms* are concerned in cases of enteroliths located in front of a bowel stricture, as a rule they have been those of a chronic or intermittent ileus and such as are found in strictures due to tuberculosis of the bowel. In cases of solitary, larger stones, the symptoms have corresponded with those of ileus caused by gall-stones, a finding which also agrees well with the proposition that the concrements have been formed in diverticulae and secondarily invaded the bowel where they immediately have given symptoms. Most likely stones of a diverticular origin which are found in the bowel are considerably more common than formerly believed but most of them are relatively small and therefore pass through the intestinal tract without symptoms or they produce only rapidly subsiding, milder symptoms of obturation, the cause of which is never explained. It is also most likely the fact, as PHILLIPS (1920/1921) and later other authors have pointed out, that in some cases which have been labelled gall-stone ileus, the concrement had been an enterolith.

A condition concerning the choleic acid stones which deserves to be pointed out is that all the eleven patients observed so far have been middle-aged or older women. One patient has been operated twice for such stones. That does not at all exclude that even men can suffer from this disease but it does justify the theory that women are more disposed to it than men. A similar distribution is very evident in cases of gall-stones. In three of the eleven cases with choleic acid enteroliths gall-stones have been present concomitantly, in three examinations have proved the biliary tracts to be normal and in the others information is lacking on this point. At least it is possible that the greater tendency to the

formation of gall-stones as well as enteroliths in women can be caused by the same factors. Any specially favourable state of acidity for the precipitation of choleic acid or any larger number of diverticulæ in women than in men is not present as far as I know.

In cases where solitary enteroliths have caused symptoms of ileus in a bowel which is not constricted, the *treatment* corresponds to that of gall-stone ileus. Of course, cases in which a coincidental constricting bowel tuberculosis is present are best treated by resection of the whole altered section of the bowel.

### Summary.

In the reported case of choleic acid enterolith, the disease attacked a woman, as it had done in all the other ten cases which are to be found in the literature.

The chemical conditions necessary for the formation of enteroliths are always present and therefore most likely the essential cause must be of a mechano-physical nature. Organic changes of the bowel can cause the retention of developing enteroliths and by stagnating of the chymus favour the depositing of concretum-forming substances. There is reason to suppose that diverticulæ and bowel strictures play a dominating rôle in the creation of true bowel stones.

The process through which enteroliths of different chemical nature have been formed is principally the same, the composition of the stone being an expression only of the chemical surroundings and especially of the acidity of the chymus at the site of the creation. A low pH, such as is found in the upper portion of the small bowel, enhances the precipitation of choleic acid. An alkaline reaction which is necessary for the creation of stones of mineral salts can be found only in the lower ileum. Other enterolith-forming substances, e. g., calcium oxalate and zinc sulphide, can precipitate either in an acid or alkaline medium.

Without exception the cases of true small bowel stones can be grouped into two different types: 1) a solitary, rounded, larger enterolith obturating a small bowel which has no other hindrance for passage through it, and 2) one or more, often small, concretions found just above an incomplete constriction.

Concrements of the first type most likely have been formed in diverticulæ and at times, if large enough, have caused symptoms



when delivered into the free lumen of the bowel. Most choleic acid stones have been of this type.

Among the concretions of the second type, the stones of mineral salts no doubt have been formed in the local dilatation of the bowel immediately in front of the obstruction. Enteroliths of other chemical composition can also have developed in diverticulæ higher up in the bowel and been stopped, after having invaded the free gut, in front of the stricture.

### Zusammenfassung.

In dem hier mitgeteilten Falle von Choleinsäureenterolith traf das Leiden, wie auch in den 10 früher veröffentlichten, eine Frau.

Die chemischen Voraussetzungen für die Enterolithenbildung sind stets vorhanden, und die Ursache der letzteren muss also vorwiegend mechanisch-physikalischer Natur sein. Anatomische Darmveränderungen können in Bildung begriffene Enterolithen festhalten und durch Chymusstagnation die Ablagerung konkrementbildender Substanzen begünstigen. Es liegen Gründe vor anzunehmen, dass Divertikel und Stenosen des Darmes für die Entstehung von echten Darmsteinen eine überragende Rolle spielen.

Die Entstehungsweise der Enterolithen von verschiedener chemischer Natur ist im Prinzip gleichartig; ihre Zusammensetzung stellt nur einen Ausdruck für das chemische Milieu und besonders für die Azidität des Chymus an der Entstehungsstätte dar. Niedriges pH, wie es im oberen Dünndarm vorkommt, begünstigt die Ausfällung von Choleinsäure. Die für die Entstehung von Mineralsalzsteinen notwendige alkalische Reaktion kann nur im unteren Ileum vorkommen. Andere enterolithenbildende Substanzen, wie Kalziumoxalat und Zinksulfid, können sowohl bei saurer als auch bei alkalischer Reaktion abgelagert werden.

Fälle von echten Dünndarmsteinen lassen sich durchwegs in zwei Gruppen einordnen: 1. Solitärer, rundlicher, grösserer Enterolith verstopft den Dünndarm ohne anderweitige Passagehindernisse. 2. Ein oder mehrere, oft kleinere Konkreme werden unmittelbar oberhalb eines relativen Darmhindernisses gefunden.

Konkremente vom 1. Typus sind aller Wahrscheinlichkeit nach in Divertikeln entstanden und haben, nachdem sie in die freie

Darmlichtung hinein geboren wurden, Symptome gegeben. Die Mehrzahl der Choleinsäureenterolithen sind von diesem Typus gewesen.

Unter den Enterolithen vom 2. Typus sind die Mineralsalzsteine sicherlich in unmittelbar oberhalb des Hindernisses gelegenen, örtlichen Erweiterungen des Darmes entstanden. Konkremente von anderer chemischer Natur können auch in höher am Darne gelegenen Divertikeln entstanden und nach ihrer Auswanderung in die freie Lichtung des Darmes vor dem Hindernis aufgehalten worden sein.

### Résumé.

Le cas rapporté ici d'entérolithe à base d'acide cholique concernait une femme, comme les dix autres publiés antérieurement.

Les conditions chimiques requises pour la formation d'entérolithes existent chez tout le monde, de sorte que la cause de leur apparition doit être essentiellement de nature mécanique et physique. Des changements dans l'anatomie de l'intestin peuvent amener une rétention d'entérolithes se trouvant au stade de formation, et favoriser le dépôt de substances produisant des concrétions par la stagnation du chyme. Il y a des raisons d'admettre que les diverticules et les sténoses de l'intestin jouent un rôle prédominant dans l'apparition des calculs intestinaux vrais.

Le mode de formation des entérolithes de nature chimique différente est en principe le même, leur composition étant seulement la traduction de l'état chimique du milieu, et spécialement celle de l'acidité du chyme à l'endroit de leur naissance. Un pH bas, tel qu'on l'observe dans la partie supérieure de l'intestin grêle, favorise la précipitation de l'acide cholique. Une réaction alcaline, indispensable à la formation de calculs composés de sels minéraux, ne peut se rencontrer que dans l'iléon inférieur. D'autres corps pouvant donner des entérolithes, comme l'oxalate de chaux et le sulfate de zinc, sont capables de précipiter aussi bien en milieu acide qu'en milieu alcalin.

Les cas de calculs authentiques de l'intestin grêle peuvent, dans l'ensemble, se ramener à deux types différents: 1) Un entérolithe solitaire, arrondi, d'assez grande taille, obture une anse intestinale sans qu'il y ait d'autres obstacles sur le viscère. 2) Une ou plusieurs concrétions, souvent plutôt petites, sont trouvées

immédiatement au-dessus d'un obstacle arrêtant incomplètement le transit intestinal.

Les concrétions du premier type se sont, avec la plus grande vraisemblance, formées dans des diverticules, et n'ont donné lieu à des symptômes qu'après avoir été accouchées dans la lumière, libre, de l'intestin. La plupart des entérolithes à base d'acide cholique étaient de cette espèce-là.

Parmi les entérolithes du second type les calculs de sels minéraux se sont certainement formés dans des dilatations localisées de l'intestin, juste au-dessus de l'obstacle. Les concrétions d'autre nature chimique peuvent aussi s'être formées dans des diverticules plus haut dans l'intestin, et, après avoir émigré dans sa lumière, s'être trouvées arrêtées devant l'obstacle.

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(From the Institute of Medical Chemistry, Upsala.)

## Chemical Investigation of the Enterolith in Grettve's Case and a Report of a Further Case of a Primary Calculus of the Small Intestine.

By

GUNNAR BLIX.

The chemical analysis of the enterolith in the case reported by GRETTE was carried out in the same way as described in an earlier case (BLIX, 1935). The analytical result is summed up below.

Water .....	6.6 %
Choleic acid.....	approx. 79 %
Calcium oxalate .....	» 3 %
Fatty acids and cholesterol .....	1.6 %

The rest (about 10%) consisted mainly of bile pigments. A determination of the ash content gave 1.8 %. The ash was rich in calcium and phosphate. Magnesium and iron were present in traces only. Zinc could not be detected.

The isolated choleic acid melted at 185°—186° after one recrystallisation from alcohol. The substance gave an intense fluorescence with concentrated sulphuric acid and a strongly positive Pettenkofer's test. For further identification the substance was transformed into the aceto-choleic acid. The latter showed a melting point of 143°—144°, which agrees well with that given for the aceto-choleic acid by WIELAND and SORGE (1916).

In this connection it appears proper to give a short report of a case of calculus of the small intestine, which some years ago was forwarded to me for chemical analysis by Dr. J. WALDENSTRÖM, at that time Chief Surgeon at the Falun Central

Hospital. Dr. WALDENSTRÖM has kindly furnished the following clinical data:

A man, 54 years of age, had been operated on in 1937 for cholelithiasis and acute cholecystitis. He had later on several occasions had short attacks of pains in the abdomen. Before admission a similar attack of longer duration. On admission the abdomen was distended. There was a marked tenderness with muscular defense below the navel. On operation a bladder-formed, gangrenous Meckel's diverticulum was found. It had the size of an orange, with a base only a few centimeters in diameter. The diverticulum was excised and it was necessary also to resect a part of the adjacent intestine. The diverticulum contained several concretions, of which one was sent for chemical investigation.

The enterolith, which weighed about 4 g, had a flattened form and a smooth, brownish black surface. The dark colour was evidently due to bile pigments. The dark coloration was limited to a surface layer which was only about 1 mm thick, whereas the interior of the stone had a brighter brownish colour. The surface layer was removed from the rest and analysed separately. The results of the analyses are presented below.

	Interior of the enterolith	Surface layer
Water .....	3.6 %	4.6 %
Calcium oxalate ..... approx.	56 %	70 %
Substance soluble in organic solvents	21 %	4 %
Zinc sulphide.....	0.9 %	—

The interior of the stone gave a small fraction only of "substance soluble in organic solvents" which could be dissolved in light petroleum. This fraction consisted of fatty acids and cholesterol. The rest could be dissolved in ethanol and the solution deposited a crystalline precipitate on concentration. The washed and dried crystals melted at  $+180^{\circ}$ . The crystalline substance gave an intense fluorescence with concentrated sulphuric acid and a strongly positive Pettenkofer's test. Mylius' test for cholic acid was negative. The small amount obtained did not permit any further tests, but there can hardly be any doubt about that at least the main part of the alcohol soluble fraction consisted of *choleic acid*. If all the substance soluble in alcohol but insoluble in light petroleum consisted of choleic acid, the choleic acid content of the interior of the concretion should have amounted to about 19 %. The fraction of the interior which has not been

accounted for above consisted evidently chiefly of bilirubin calcium.

The small fraction of the surface layer soluble in organic solvents gave positive qualitative reactions for bile acids but allowed no further tests. The surface layer contained neither carbonate nor magnesium ammonium phosphate. Phosphate was indeed present only in traces. Zinc could not be detected. The part of the surface layer not accounted for in the table consisted mainly of bilirubin calcium.

The enterolith here examined can be characterised as a *calcium oxalate* stone, which contains bile pigments and choleic acid as accessory components. It is of interest that zinc sulphide could be demonstrated also in this case. In chemical respect this concretion agrees rather closely with that of the case communicated in 1935 (BLIX, 1935).



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(Physician-in-Chief: Professor HILDING BERGLUND.)

# **Effect of Pentaerythrittetranitrate on Pain and Elevations of Serum Amylase and Bilirubin Induced by Simultaneous Injections of Morphine Hydrochloride and Secretin in Patients with Biliary Dyskinesia.**

By

HENRIK O. LAGERLÖF.

The beneficial effect of amyl nitrite and glyceryl trinitrate on biliary colics is known for many years. Its therapeutic use is actualized by the experiments of Mc GOWAN, BUTSCH & WALTERS (1936) which show that those drugs decrease the increased resistance of Oddi's sphincter produced by morphine. The action of nitrite preparations with more sustained action has recently been investigated by BERGH (1942) with negative result.

In this work the effect of pentaerythrittetranitrate on biliary colic, produced by morphine in cholecystectomized patients with biliary dyskinesia was studied. The experiments were done, when the patients were fasting. One to two tablets of pentaerythrittetranitrate (nitropent, Astra) were given by mouth and about 1 hour later 10 mg morphine hydrochloride was administrated subcutaneously. Immediately after the morphine injection 80 clinical units of secretin (pancrotest, Astra) were injected intravenously. Serum samples were taken immediately before and four hours after the morphine injection. The concentrations of serum amylase was determined according to NØRBY with a slight modification, giving about 16 per cent lower values than the original method (LAGERLÖF, 1942), and the serum bilirubin was determined according to JENDRASSIK & GRÓF (1938). Occurring pain was noted. In most experiments additional tablets of pentaerythrittetranitrate were given about 2 hours after the morphine injection.

In control experiments on other days the same procedure was repeated without administration of pentaerythritetranitrate.

The results are compiled in table 1.

In the control experiments all the patients suffered from severe biliary colic. The first complaint in some cases was a dull ache in the epigastrium, but usually the biliary colics came abruptly 15 to 45 minutes after the morphine injection. They then lasted with high frequency and strength for some half an hour and then slowly faded away. After three hours as a rule only some dull ache in the epigastrium remained.

In 3 of the pentaerythritetranitrate experiments there were no pains. In further 4 there was much less pain than in the control experiments. The pains appeared later, were less frequent and strong and vanished after a few seizures. In one patient, a badly neurotic woman, the pains were felt worser.

The increase of serum amylase and bilirubin, which followed the injections of morphine and secretin was much less pronounced in the experiments with pentaerythritetranitrate. The differences between the increases of the tests for the amylase was  $89 \pm 13$  Nørby units  $\times 10,000$  and for the bilirubin  $0.661 \pm 0.169$  mg per 100 Ml and thus significant for both amylase and bilirubin.

For the interpretation of the effect of pentaerythritetranitrate on the increase of serum amylase, produced by morphine and secretin an additional experiment was done. After an ordinary secretin test (LAGERLÖF 1942) in two cholecystectomized patient 60 mg of pentaerythritetranitrate were given in the duodenal part of the tube which was then thoroughly rinsed with water. The tube was clamped for 30 minutes, the duodenal content removed and a new secretin test performed. In the first patient the volume in the first test was 142 Ml, the amount of bicarbonate 13.0 Eq. and the amount of amylase 480 NØRBY units in one hour. The corresponding figures for the second test were 148, 13.4 and 440. In the second patient the corresponding values were 334, 22.7 and 942 in the first test and 314, 23.8 and 863 in the second. As the coefficients of variation of volume and amylase in to successive ordinary secretin tests are only 5.81 and 9.25 respectively it is evident that the pentaerythritetranitrate does not or to a very faible degree influence the biliary or pancreatic secretion after secretin.

Table  
*Effect of Pentaerythritetranitrate*

Journal	Date	Number of tablets à 30 mg.	Time of administration		Amy- Norby units	
			before morphine min.	after morphine min.	0 hours	4 hours
6418/43	<sup>21</sup> / <sub>11</sub> 43				37	68
	<sup>25</sup> / <sub>11</sub> 43	1 <sup>1</sup> / <sub>2</sub> 1 <sup>1</sup> / <sub>2</sub>	60 min. 15 "		41	48
1923/44	<sup>2</sup> / <sub>12</sub> 43				22	388
	<sup>3</sup> / <sub>12</sub> 43	1 <sup>1</sup> / <sub>2</sub> 1	60 min. 2 "	160 min.	122	214
433/44	<sup>21</sup> / <sub>1</sub> 44				35	618
	<sup>24</sup> / <sub>1</sub> 44	2 1 1	50 min.	70 min. 130 "	38	192
474/45	<sup>24</sup> / <sub>1</sub> 44				35	192
	<sup>26</sup> / <sub>1</sub> 44	2	35 min.		41	122
540/44	<sup>26</sup> / <sub>1</sub> 44				14	74
	<sup>8</sup> / <sub>2</sub> 44	2 1	45 min.	120 min.	12	32
747/44	<sup>4</sup> / <sub>2</sub> 44				14	51
	<sup>18</sup> / <sub>2</sub> 44	2 1	40 min.	90 min.	13	22
1016/44	<sup>9</sup> / <sub>3</sub> 44				22	38
	<sup>24</sup> / <sub>3</sub> 44	2 1	40 min.	100 min.	20	50
5569/44	<sup>5</sup> / <sub>2</sub> 45				26	132
	<sup>16</sup> / <sub>2</sub> 45	2 1	65 min.	15 min.	36	84
693/44	<sup>2</sup> / <sub>2</sub> 45				20	90
	<sup>16</sup> / <sub>2</sub> 45	2 1	85 min.	10 min.	21	95

### Discussion.

In the control experiments the contraction of Oddi's sphincter produced by morphine caused stase in the biliary and pancreatic ducts and resulting increase of serum bilirubine and amylase. As the biliary and pancreatic secretion after secretin is not or to

1.

*on the Morphine-Secretin Test.*

Iase × 10,000		Bilirubin mg/100 Ml				Pains
4—0 hours	Difference 1—2 test	0 hours	4 hours	4—0 hours	Difference 1—2 test	
31	24					+++
7						(+)
366	264	1.05	2.4	1.35	0.52	++
102		1.06	1.89	0.83		(+)
583	329	0.56	1.49	0.93	0.95	+++
154		0.58	0.56	—0.02		0
157	76	0.49	0.70	0.21	0.12	+++
81		0.75	0.84	0.09		0
60	40	1.93	2.37	1.34	1.06	+++
20		0.46	0.74	0.28		0
37	28					+++
9						0
16	—14	0.53	1.86	1.33	1.30	++
30		0.26	0.29	0.03		0
106	58	0.73	1.38	0.65	0.45	++
48		0.43	0.63	0.20		+
70	—4	0.74	1.28	0.23		(+)
74		0.12	0.31			+
	89 ± 13			0.661 ± ± 0.169		

a very faible degree changed by the administration of pentaerythritetranitrate, the lowered increase of serum amylase and bilirubin in the pentaerythritetranitrate experiments indicates, that the drug has a longstanding spasmolytic effect on Oddi's sphincter. The same is borne out by the prevention or decrease of the pain occurring in the control experiments.

The spasmolytic effect of amyl nitrate and glycerin trinitrate on Oddi's sphincter sets in promptly but vanishes in 10 to 20 minutes. As biliary colics in biliary dyskinesia and else may persist for hours or days those preparations should be combined with preparations with more sustained effect. The experiments just described and clinical experience gained in patients with biliary dyskinesia shows that pentaerythritetranitrate has such properties.

### Summary.

Administration of pentaerythritetranitrate diminishes the spasm of Oddi's sphincter, which is caused by morphine, and likewise the resulting pain. It is of therapeutic value in biliary dyskinesia.

### Zusammenfassung.

Pentaerythritetranitrat vermindert den durch Morphinum erzeugten Spasmus des Sphincter Oddi und den durch den Spasmus verursachten Schmerz. Die Droge ist bei Dyskinesie der Gallenwege von therapeutischem Wert.

### Résumé.

Le Tétranitrate de Pentaérythrite diminue le spasme du sphincter d'Oddi causé par la morphine, ainsi que la douleur que provoque le spasme. Le médicament a une valeur thérapeutique dans la dyskinésie des voies biliaires.

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## Studies on the Scalenus Anticus Syndrome.

By

SVANTE ANNERSTEN.

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### General Remarks.

The symptoms in the hand and arm produced by compression of the brachial plexus or subclavian artery, grouped under the term scalenus anticus syndrome, were earlier assumed almost invariably to occur in association with a cervical rib. Since ADSON and CORREY, in 1927, reported that the incidence of cervical ribs was 0.056 per cent in a total of 540,413 "normal patients", and that only 45 percent of the cervical ribs produced symptoms, increasing interest has been given to cases of scalenus anticus syndrome without a cervical rib, which nowadays occur with much greater frequency than those with a cervical rib. In 1935, OCHSNER, GAGE and DE BAKEY investigated cases of scalenus syndrome without a cervical rib. They stated that since these symptoms usually do not appear until adult life contraction and spasm of the scalenus muscle, which results from irritation and stimulation of the brachial plexus, some of the fibres of which supply the scalenus muscle, produce an abnormal elevation of the first thoracic rib. They observed a definite lowering of the first thoracic rib after division of the scalenus muscle.

Among other authors TODD stated that the shoulder girdle descends with advancing years causing lowering of the arms and a sharper kink of the subclavian vessel and brachial plexus as they pass over a normal or abnormal rib. The brachial plexus is in fact in closer apposition to the first rib than the artery. The subclavian sulcus on the first rib is said to be formed by the brachial plexus and not by the artery. Identification of this

kink may present real difficulty at operation. On the other hand, one often observes that the artery is squeezed into the angle formed by the scalenus ventralis<sup>1</sup> and the first rib or the cervical rib. The spontaneous relief which division of the scalenus ventralis alone gives in many cases, is evidently in support of the fact that the scalenus muscle *per se* plays an important mechanical part in the syndrome. This was particularly emphasized by AYNESWORTH, who in studying twenty cases determined the mechanical factors. He attached major importance to dropping of the shoulders, compression of the nerve trunks and the artery due to pressure on the part of the rib, injury to the fibres of the sympathetic nerve system produced by the rib or scalenus muscle, traumatism and fibrosis of the scalenus ventralis spasm and myositis of this muscle, alteration of the course of the nerve trunks and cicatrization in the pleural cap.

DONALD and MORTON treated forty cases by operation and found that the scalenus ventralis was either sclerotic or hypertrophic in the majority of their cases. S. LINDGREN collected cases with abnormal ribs. EDEN compiled cases, where an abnormally low position of the clavicle compressed the artery against the first thoracic rib. A single trauma seems rarely to be the etiologic factor whereas fibrous bands in the region of the scalenus muscle are often reported to account for the syndrome.

The symptoms under the general heading scalenus anticus syndrome include two well-defined categories, viz. cases exhibiting vascular symptoms, and cases presenting neurologic symptoms as their major manifestation. Vascular symptoms are most common in the presence of a cervical rib. MC FEE collected 360 cases of scalenus syndrome, 235 exhibiting neurologic and 19 vascular symptoms. 106 of them were examples of the mixed type. ADSON and COFFEY stated that of a total of 303 cases, 5.6 per cent exhibited vascular symptoms alone.

Some authors, *e. g.* EDEN, LEWIS and PICKERING differentiate between the manner of origin of neurologic symptoms and that of vascular symptoms. They hold the view that vascular symptoms are solely due to direct pressure upon the artery caused by inherent anatomic variations, a rib or transverse process causing injury to the intima and thrombo-embolism. Other authors, *e. g.* HILL, TODD, TELFORD, and STOFFORD expressed the view that injury to the artery was essentially brought about by vasomotorial

<sup>1</sup> In older nomenclature: Scalenus anticus.



Fig. 3 a.



Fig. 3 b.

Fig. 3. Determination of index.



seventh cervical vertebra as compared to that of the first thoracic vertebra.

Costotransverse process of the seventh cervical vertebra  $\cdot 100$

$$\text{Index} = \frac{\text{Transverse process of the first thoracic vertebra}}{\text{Costotransverse process of the seventh cervical vertebra} \cdot 100}$$

The index was determined in this manner in more than 400 roentgenograms of the neck. If definite and suspect cases of

### *Index on the whole material.*

	Num- ber.	Right Medium.	Left Medium.
A. Normal cases	307	$84 \pm 0.41$	$84 \pm 0.45$
B. Cases without symp- toms but with large proc.	33	$112 \pm 3.49$	$111 \pm 3.71$
A+B <sup>y</sup>	330	$86 \pm 0.49$	$86 \pm 0.54$
C. Suspicious scalenus- cases.	45	$102 \pm 2.85$	$105 \pm 3.48$
D. Operated scalenus- cases.	22	$106 \pm 3.97$	$105 \pm 4.60$
C+D <sup>y</sup>	52	$100 \pm 1.81$	$99 \pm 1.60$

<sup>y</sup>Without cervical ribs

Fig. 4. Mean of the index on the left and right side for different groups, obtained by means of x-ray photographs.

scalenus anticus syndrome and frank cervical ribs are excluded, (the accurate length of a cervical rib is difficult to determine in the roentgenogram) a mean index number of  $86 \pm 0.49$  is obtained in the remaining 330 normal cases. In 22 cases of scalenus anticus syndrome treated by operation the index was  $106 \pm 3.97$ . In 45 suspect cases of scalenus anticus syndrome it was  $102 \pm 2.85$ .<sup>1</sup> In the group including both suspect and definite cases of scalenus anticus syndrome *without* cervical ribs the index was  $100 \pm 1.81$ . This figure should be compared to the index of  $86 \pm 0.49$  obtained in the normal cases (fig. 4). The difference ( $14 \pm 1.9$ ) is statistically significant and shows,

<sup>1</sup> In selecting "suspect cases of scalenus anticus syndrome" I first studied the histories of the cases and then I made a careful search of the roentgenograms.

that in normal cases the costotransverse process of the seventh cervical vertebra is shorter than the transverse process of the first thoracic vertebra, whereas in most cases of scalenus anticus syndrome it is either longer than the transverse process of the first thoracic vertebra or these two processes are of identical length. (Fig. 5 and 6.)

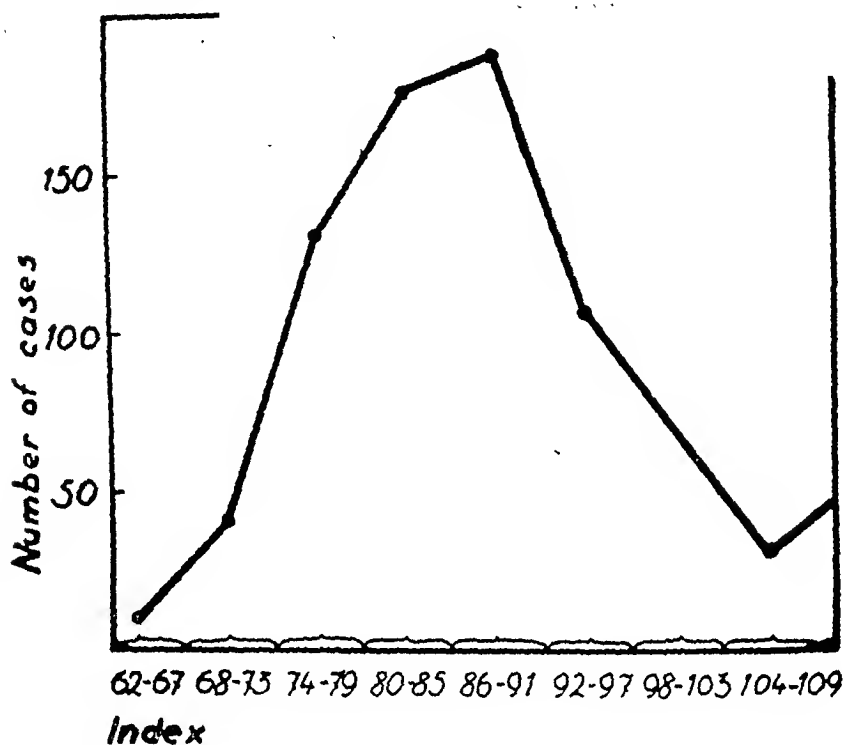


Fig. 5. Distribution of the whole number of cases according to their index.

The most reasonable explanation of the scalenus anticus syndrome would be that it is produced by compression of the brachial plexus between the scalenus ventralis-muscle and the costotransverse process of the seventh cervical vertebra. The larger the latter the greater is the possibility of compression.

As the muscle may be changed so may also the osseous protuberance present an abnormal appearance, a fact which has been borne out by my measurements. The brachial plexus emerges behind the muscle, and at operation it may be plainly seen that the lower rami of the brachial plexus pass immediately over the osseous protuberance. The longer the latter the more easily is the brachial plexus compressed by the normal or abnormal scalenus ventralis lying in front of it. Moreover, fibrous bands of tissue extending from this enlarged protuberance may function-

ally play the part of a cervical rib. This mechanism may thus be concerned not only in the origin of neurologic symptoms but also in the origin of vascular symptoms if they are produced by injury to the sympathetic nerve fibres following the lower rami of the brachial plexus. It should here also be mentioned that skeletal anomalies are generally bilateral (fig. 4) whereas the symptoms are, as a rule, unilateral. This applies also to cases of a cervical rib in that only one-half of them give symptoms. Of the 27 cases I collected, however, three cases exhibited symptoms on both sides. These observations would suggest that anatomical

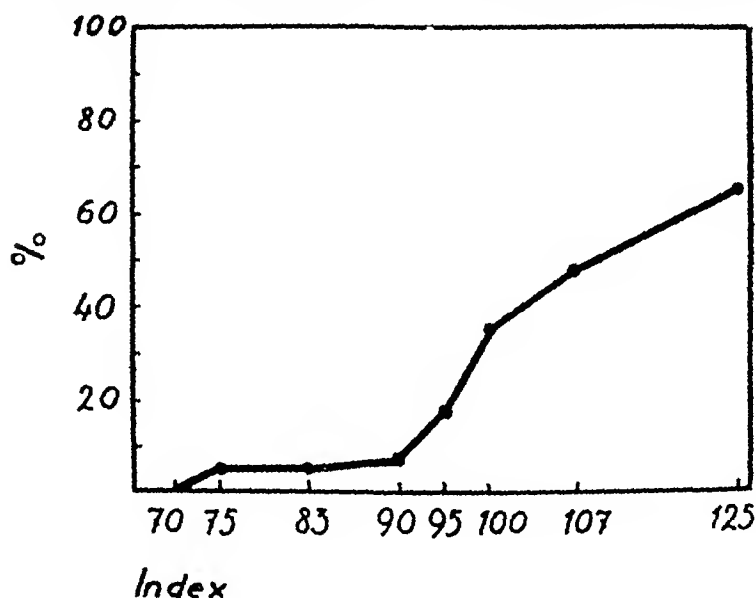


Fig. 6. Percentage of cases with scalenus anticus syndrome at different indices.

variations are essentially the prerequisites and that other factors, viz. lowering of the shoulder girdle, overstraining of the scalenus muscle or abnormalities of this muscle are necessary to precipitate the symptoms. In suspect cases exhibiting *neurologic or vascular symptoms in the arm, and in cases with a history of pains in the region of the shoulders not uncommonly offering real difficulty in diagnosis, an enlarged costotransverse process of the seventh cervical vertebra is a valuable diagnostic aid in that it strongly suggests the scalenus anticus syndrome.* Naturally, the possibility of spondylosis deformans and osteochondrosis of the cervical spine should also be taken into consideration. Symptoms from these pathologies are at times not unlike those from the scalenus anticus syndrome of the neurologic type.

## The Clinical Picture in Cases Treated by Operation.

On analysing the cases under discussion, which were collected from the Akademiska Sjukhuset of Upsala — 412 altogether — valuable information on the clinical picture is obtained. In 23 or 5.5 per cent of these cases a cervical rib was present. In 13 or 56.5 per cent of the 23 cases with a cervical rib, the patients manifested symptoms though only in 7 cases or 30 per cent of the cases with a cervical rib the symptoms were so severe as to warrant operative interference. Of the 72 patients manifesting symptoms suggesting scalenus anticus syndrome, 13 or 18 per cent presented a cervical rib.

With the exception of three cases, one of which presented cervical ribs, where the patients manifested symptoms on both sides, unilateral symptoms predominated. In one of them the symptoms were not so severe as to call for operation whereas scalenotomy was performed in two, where a previous operation on one side had yielded so favourable results that the patients requested to be operated upon also on the other side.

The present investigation is based on 27 cases, in which the scalenus anticus syndrome constituted the indication for operation. On re-examining these patients it was found that the operative interference had not given any relief in two cases, one 10 years and the other one year after operation. *The index was low in both cases.* In one there was degeneration of the intervertebral disk and in the other the patient probably suffered from neuritis. A third patient with a cervical rib and spondylosis deformans of the cervical spine was very little improved. This patient complained also of pains in the chest due to injury of the phrenic nerve. The remaining patients were either symptom-free or considerably improved after operation, *especially as regards pains, which had completely disappeared (table, fig. 7).* These cases illustrate the importance of a careful examination of the cervical spine in differential diagnosis.

I feel that the generally accepted classification into cases with neurological symptoms and cases with vascular symptoms is reasonable although the two concepts overlap to some extent in cases where sympathetic fibres of the brachial plexus are damaged. Differentiation between these two types of symptoms may occasionally present some difficulty. Pains may be elicited by both ischemia and compression of the nerve. Impaired sensibility may

Sex	Age, Years	Duration of symptoms	Index		Diff. in oscillographic readings before op.	Pressure on Art. Subel. (A) Pressure on plexus (P)	Affected side (R or L)	Vascular symptoms Neurologic symptoms (+ or -) V. N.		Operation
			Right	Left						
♀	57	3 months	116	160	—	A	L	+	—	Resect. costac. alcohol inj. into the stellate gangl.
♀	56	6 months	125	153		A + P	L	+	—	Resect. costac
♂	34	10 years	108	116		A + P	R	+	+	Resect. costac
♀	20	3 years	155	139	—	A + P	R	+	+	Resect. costac
♀	52	1 month	100	102	—	A	R	+	+	Scalenotomy
♀	38	3 months	116	117	0	P	R	—	+	Scalenotomy
♀	52	3 years	102	200	—	A + P	L	+	+	Resect. costac
♂	52	1 year	78	77	—	A	L	+	—	Resect. costae I
♂	44	1 year	113	120	—		R	+	+	Scalenotomy, arteriography
♀	66	1 year	100	98	—		R	+	+	Scalenotomy, alcohol inj. into the Stellate gangl.
♀	44	2 months	116	95	+	A + P	R	+	+	Scalenotomy
♀	37	1 year	117	119	+	A	L	+	+	Scalenotomy
♀	46	2 months	109	90	—	P	L	+	+	Scalenotomy
♀	42	6 months	88	87	0		L	—	+	Scalenotomy
♀	13	6 months	114	104	—	A	R	+	+	Scalenotomy
♀	49	5 years	129	104	0	P	R	—	+	Scalenotomy
♀	36	1 year	123	107	0	P	R	+	+	Scalenotomy, periartr. sympatectomy
♂	43	1 month	97	106	0	P	R	+	+	Scalenotomy
♂	22	5 years	78	79	0	A	L	+	+	Scalenotomy
♂	45	2 months	84	84			L	—	+	Scalenotomy
♂	52	2 years	91	85			R	+	+	Scalenotomy
♂	49	10 years	92	95	0		R	+	+	Scalenotomy
♀	25	1 year	91	90		A	R	—	+	Scalenotomy
♀	22	6 months	89	102		A	R	+	—	Scalenotomy
♀	22	2 months	81	86	—	P	R	+	—	Scalenotomy, alcohol inj. into the Stellat. gangl.
♀	26	2 years	129	126			R	—	+	Scalenotomy
♀	20	6 months	90	84	+		R	+	+	Scalenotomy

1 Cervical rib.

Fig. 7. Table

Results (symptomfree, improved, not improved)	Diff. in oscillo- metric readings after op.	Follow-up-time	Postoperative complaints	Remarks
improved	—	1½ years	Atrophy of the hand. Coldness	Arterial thrombosis on the left. Bilate- ral. Incapable of work- ing before op.
symptomfree	—	8 years	Slight coldness	
improved	—	6 years	Atrophy of the then- ar muscles. Slight coldness.	
improved	—	3 months	Atrophy of the then- ar muscles	
improved	0	1 year	Atrophy of the then- ar muscles	No response to cold reaction test before op.
symptomfree	0	2 months	0	
improved	—	4 months	Atrophy of the hand. Coldness, Numb- ness	No response to cold reaction test before and after op. Cer- vical spondylosis. Arterial thrombosis. Abnormal costae I.
improved	—	10 years	Atrophy of the hand. Coldness	
improved	0	8 years	Atrophy of the then- ar muscles, cold- ness	
symptomfree	0	10 months	Minimal atrophy of the thenar muscles	No response to cold reaction test before op.
symptomfree	+	8 years	0	
symptomfree	0	5 years	0	Bilateral
symptomfree	—	5 months	0	
improved	0	4 months	Impaired sensibility in the ulnar reg.	
symptomfree	—	4 months	0	
symptomfree	0	6 months	0	Trauma.
symptomfree	0	2 years	0	
symptomfree	0	6 months	0	No response to cold reaction test before op.
improved	0	5 months	Reduced grasp.	
symptomfree	0	3 months	Numbness. Minimal feeling of numbness	Cervical osteochon- drosis. (Prolapse of the intervertebral disc?) Neuritis Bilateral
improved	0	8 years	Same symptoms as before op. Less se- vere pain.	
not improved	0	5 months	Pains and weakness	
symptomfree	0	6 months	0	
improved	—	2 months	Atrophy of the then- ar muscles. Cold- ness before alcohol inj.	Trauma.
symptomfree	0	2 months	0	
symptomfree	0	5 months	0	

be due to both severance of nerve fibres of the brachial plexus and extreme ischemia. *Abnormal oscillometric readings, however, are definite signs of a vascular affection* due either to vasomotorial disturbances or direct occlusion of the subclavian artery. This applies also to pallor, coldness, cyanosis, acroparesthesia and spasms of the hand, fingers, and forearm. As a rule, the patient notices first pallor and numbness of the fingers associated with coldness and weakness of the muscles on the affected side. Generally the *radial fingers, i. e. the thumb and the index* are the first to be involved. *The pains are, as a rule, spastic in character*, and generally they commence after specific movements or exertion (ischemic pains). Aneurysm and formation of thrombi occur at a later stage. *The neurologic type is characterized by pains which are continuous in character, frequently localized in the ulnar part of the forearm and the hand, ring finger and little finger.* Further characteristics of the neurologic type are segmentally impaired sensibility and reduced grasp. The muscular atrophy of the hand may be due either to vascular or neurologic disturbances though atrophy of the thenar muscles suggests vascular disturbances rather.

Fig. 7 shows that only five cases or approximately 18 per cent warrant to be classed as purely vascular in type. Solely neurologic symptoms without demonstrable signs of vascular disturbances were exhibited by six cases or approximately 22 per cent. There is an overwhelming predominance of mixed cases constituting about 60 per cent (16 cases). The oscillometric readings were appreciably impaired on the side operated upon before operation in 10 cases or approximately one-third of the patients. In two of them manifesting brachial thrombosis no oscillations were perceptible. In three additional cases the oscillometric values were *higher* on the side operated upon.

According to the records of the operative findings direct compression of the subclavian artery was identified in 12 patients, who all had vascular symptoms. The subclavian artery was directly compressed in six of the seven cases with a cervical rib included in this group. This group embodies also two cases of aneurysm. In five of the 13 cases which are definite examples of the vascular type and where oscillometric differences were recorded, there are no data on compression of the artery. The possibility that it was present can thus not be definitely ruled out. These data furnish to some extent evidence in support of the

importance of direct injury to the artery in producing vascular symptoms.

On the other hand the records state that in seven of the 13 cases just mentioned there was also compression of the brachial plexus; in two there was *solely* compression of the brachial plexus. Of the five cases where *solely* compression of the brachial plexus was found, the two last mentioned cases showed differences in the oscillometric readings.

A study of the oscillometric readings after operation furnishes interesting information. In the 10 cases where the oscillometric readings were impaired on the affected side before operation, the oscillometric readings were with the exception of the two cases of thrombosis, the same on both sides two to seven days after operation. Only one of the thrombosis cases was controlled after operation and it was found that there were still no oscillations perceptible on the affected side. In five of the remaining cases the patients were re-examined about two months after operation and the oscillometric readings were found to be again impaired, *i. e.* they were about the same as before operation. In three cases the oscillometric values were higher on the affected side before operation. In one instance the higher values persisted after operation whereas in the remaining two cases the oscillometric readings improved and were the same on both sides. In two further cases where no oscillometric examination was made before operation the control examination after operation showed that the oscillometric readings on the side operated upon were impaired. They had probably also been impaired before operation. Of the 12 cases, in which the oscillometric readings were impaired on the affected side before operation, 9 showed impaired oscillometric readings also after operation although the patients were either almost or completely symptom-free after operation. A characteristic feature of these cases is *that operation had given complete relief from pain* though coldness of the fingers or atrophy of the thenar muscles had not subsided in six. The oscillometric readings are about the same as before operation in these cases (fig. 8). It appears thus that pains would in the main be determined by compression of the nerve fibres of the brachial plexus, which is completely relieved by scalenotomy whereas impaired oscillometric readings point towards an alteration of the wall of the vessel, on which operation has no lasting effect. Considering the *temporary* increase in the blood supply to the vessel, however,



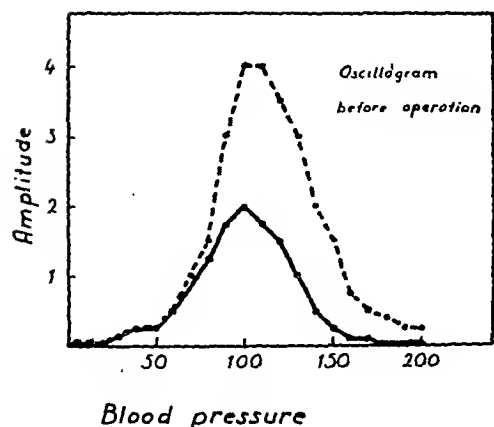


Fig. 8 a.

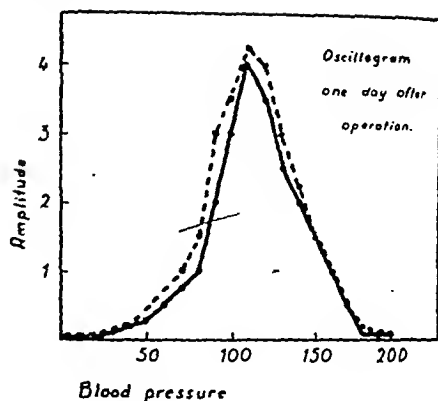


Fig. 8 b.

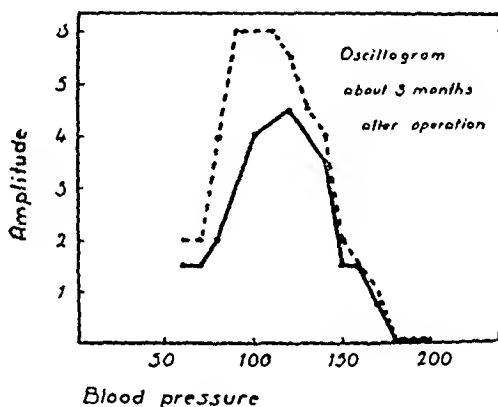


Fig. 8 c.

Fig. 8. Oscillometric readings before, immediately after and three months after operation.

————— The affected arm.  
- - - - - The unaffected arm.

it is most unlikely that a major organic defect is present unless, of course, there is thrombosis. It is difficult to offer a satisfactory explanation of the fresh impairment of the oscillometric readings subsequent to operation. It is hardly possible that cicatricial connective tissue can give rise to pressure after so short a time. The most feasible explanation would be that the impaired oscillometric readings are due to contractions of the muscles of the wall of the vessels occurring as sequel of the pressure produced by the scalenus muscle upon the artery before operation. It is hardly probable that a fresh pressure against the vasoconstrictors of the brachial plexus is created or that pressure can persist after scalenotomy without being accompanied by pains.

Periarterial vasoconstrictors do not seem to exist in the peripheral part of the subclavian artery (SMITHWICK), and therefore it is not possible that direct pressure upon the wall of the artery can give rise to vasomotorial disturbances, which otherwise would be the most reasonable explanation of the oscillometric phenoma reported above. The clarification of this problem must be left to further studies. I shall report on my experimental investigations into this question in a subsequent paper. The absence of pains in cases where atrophy of the muscles persists after operation suggests that it is of vascular, *i. e.* ischemic origin and that it is not due to neurologic disturbances caused by pressure upon the nerve fibres of the plexus.

This investigation thus brought forward evidence in support of the assumption that the vascular symptoms are produced by direct pressure on the wall of the vessel and *that this injury is irreparable in many cases*. Extreme pressure results in thromboembolism, which happened in two of the cases here reported, whereas a lesser degree of pressure gives rise to a lesser damage of the intima causing smaller embolies or formation of aneurysm. It is therefore of major importance to repair the compression of the artery as early as possible, which implies that operative interference should be more extensively applied in suspect cases of scalenus anticus syndrome of the vascular type.

Three cases in which the oscillometric examination revealed higher values on the side of the affected arm before operation, are particularly interesting. In these cases the patient exhibited predominantly neurologic symptoms and scalenotomy gave complete relief. It is hardly conceivable that these symptoms were due to any other mechanism than a paralysing pressure upon the vasoconstrictors or a possible active vasodilatative irritation. In one of them the difference in the oscillometric readings was still very great eight years after operation, *viz.* 13 to 4.5; in the remaining two cases the oscillometric readings were the same on both sides after operation. In the first mentioned case the injury to the sympathetic nerve fibres was thus irreparable whereas in the other two it was repaired. In all these cases the index was high though no cervical rib was present. The specific discomfort was experienced in the form of radiating pains in the arm and the fingers before operation. *These cases thus furnish evidence in support of the assumption that vasomotor fibres were injured, and that they converge with the most caudal fibres of*

the brachial plexus which are squeezed between the scalenus ventralis and the seventh costotransverse process.

A further phenomenon strongly suggesting vasomotorial disturbances is the negative response to the consensual cold reaction test by HULTÉN's method.

Both hands are immersed in tepid water and the increase in the temperature of the water is registered. On adding cold water to the receptacle in which the unaffected arm is immersed, normal vasoconstriction is obtained, and increase in temperature on the affected side is arrested. If the sympathicus is paralysed, however, the temperature continues to rise.

Four cases, which are examples of the mixed type, clearly illustrate this. The most feasible explanation would be that vasoconstriction here was eliminated by pressure upon the cords of the brachial plexus. The impaired oscillographic readings recorded in three of them must have been due to a direct pressure upon the artery. That this was actually the case was borne out by the operative findings. In two cases the patients responded positively to the cold reaction test though one of them not before one month and the other not before one and a half years after operation (one week and one year after operation respectively, the response was still negative).

Of the cases examined by HULTÉN's method the blood supply to the arm was impaired only in those presenting thrombosis.

Three patients were treated by alcohol injection into the stellate ganglion. It was punctured from behind with the help of roentgen examination, and after the patient manifested Horner's syndrome, 2 cc. of 85 per cent alcohol were injected. In one of these cases presenting thrombosis this treatment was given with a view to increase the collateral blood supply. Subjectively, at least, the patient improved. In the two remaining cases where coldness and numbness of the arm persisted and the oscillographic readings were impaired after scalenotomy, the patients were not only completely relieved of these symptoms but also the oscillographic readings improved after alcohol injection, *i. e.* they were the same on both sides,

*From these findings it is clear that vasomotorial disturbances, in which the sympathetic nerve system is concerned, are to some extent associated with direct injury to the wall of the artery in cases of scalenus anticus syndrome of the vascular type.*

As regards treatment (fig. 7) part of the cervical rib was resected

in five of the seven cases presenting this abnormality. In the remaining two cases scalenotomy alone was made, giving complete symptomatic relief in one, whereas in the other atrophy of the muscles of the hand and coldness persisted though otherwise the condition of the patient considerably improved. In the case of the patient presenting an abnormal first thoracic rib part of the latter was resected. In the remaining 19 cases scalenotomy was made. The injection of alcohol into the stellate ganglion markedly improved the results in three cases.

15 cases are completely symptom-free, four complain of residual though very slight discomfort, and in six, two of which present thrombosis, the persisting symptoms in the form of coldness and atrophy of the thenar muscles are severer in character. Only two of the seven cases of cervical rib are *completely symptom-free* whereas of the remaining 17 cases, which are *definite* examples of scalenus anticus syndrome without a cervical rib, 13 are completely symptom-free. The prognosis in cases of scalenus anticus syndrome with a cervical rib is thus less favourable. There is a predominance of vascular symptoms in these cases. It should here be mentioned that even if the operative interference may not give complete symptomatic relief in all cases *it invariably gives relief from pain*.

An aneurysmal spool-shaped dilatation of the subclavian artery distal to the impression was identified at operation in two cases. One of them presenting thrombosis, was not symptom-free whereas the other was completely relieved from symptoms after operation.

### Conclusion.

From these data it would appear that scalenotomy alone is sufficient in those cases where *compression of the nerve is brought about by pressure of the scalenus muscle upon the costotransverse process of the seventh cervical vertebra. This occurs if the latter is enlarged, which was the case in the majority of the cases here discussed. This compression may also give rise to vasomotorial disturbances. As a rule, the vascular symptoms are due to direct pressure upon the artery.* In cases without a cervical rib scalenotomy alone will be sufficient to give symptomatic relief. If the artery bends over an abnormal rib the latter should be resected. As regards its total resection the authors are not agreed. Some are definitely against it because it involves an extensive operation whereas

others advocate it to eliminate the possibility of regeneration. In my cases partial resection was sufficient to repair the kink of the artery and the nerve. I consider it, however, most important to eliminate the pressure brought about by the scalenus muscle either upon the artery or the brachial plexus. In cases where operation failed to give symptomatic relief, particularly if the oscillographic readings remain impaired on the affected side, the injection of alcohol into the stellate ganglion or a preganglionic operation will occasionally give symptomatic relief. The possibility of an irreparable injury to the artery, however, should always be borne in mind in cases of scalenus anticus syndrome exhibiting vascular symptoms as their major manifestation, particularly if the latter are of long standing. Considering the risk of thrombosis of the brachial artery, which catastrophically impairs the prospects of postoperative improvement one should not hesitate to make scalenotomy or to resect the rib, which both are comparatively simple operations.

### Summary.

The author determined the relative length of the costotransverse process of the seventh cervical vertebra in some 400 roentgenograms of the neck, and found that in cases exhibiting scalenus anticus syndrome it was, as a rule, longer than in normal cases. The present paper brings forward evidence that these variations in length are statistically significant. They may be expressed

length of the costotransverse process of the  
seventh cervical vertebra · 100

by an index =  $\frac{\text{length of the transverse process of the first thoracic vertebra}}{\text{length of the transverse process of the first thoracic vertebra}}$

Since the lowest rami of the brachial plexus pass between this process and the scalenus ventralis muscle the author claims that it not only has an important bearing on the scalenus anticus syndrome but that it is also a valuable aid in diagnosis. Bands of connective tissue extending from an enlarged protuberance not uncommonly converge with the scalenus muscle and produce direct pressure on the subclavian artery.

On the basis of a follow-up examination of 27 cases of scalenus anticus syndrome operated upon (seven with and 20 without a cervical rib) the author furnishes evidence in support of the assumption that the vascular symptoms though essentially due to

direct injury to the artery must to some extent also be produced by compression of the vasomotor sympathetic fibres following the caudal rami of the brachial plexus. Both the neurologic and the vascular symptoms can be explained by this mechanism. Scalenotomy generally gives relief in cases exhibiting neurologic symptoms whereas the prognosis is somewhat less favourable in cases presenting vascular symptoms, particularly in the presence of a cervical rib. As regards pains, however, *they invariably subside after this operation.*

The author emphasizes that vascular symptoms in cases of scalenus anticus syndrome definitely warrant operation because the risk of arterial thrombosis. This occurred in two of the cases in the author's material.

The injection of alcohol into the stellate ganglion after operation considerably improved three patients presenting vascular symptoms.

### Zusammenfassung.

Bei mehr als 400 Röntgenaufnahmen des Wirbelsäules des Halses hat der Verfasser durch Bestimmung der relativen Länge des Processus Costotransversarius des siebenten Halswirbels konstatiert, dass dieser bei Scalenus-anticus-Syndrome-Fällen, im Vergleich zu normalen Fällen in der Regel länger erscheint, was in dieser Arbeit statistisch bewiesen ist. Diese Variationen können in einer Index-Zahl ausgedrückt werden:

$$\text{Index} = \frac{\text{Die Länge des Proc. costotransversarius des VII. Halswirbels} \cdot 100}{\text{Die Länge des Proc. transversus der ersten Brustwirbels}}$$

Da die untersten Brachialplexus-Zweige zwischen diesem Auswuchs und dem Musculus Scalenus ventralis hindurchgehen, erblickt der Verfasser in dieser Feststellung nicht nur eine diagnostische Hilfe, sondern auch eine wichtige Ursache zur Bildung von Scalenus-anticus-Syndrome durch Quetschung des Plexus. Ausserdem konvergieren nicht selten Bindegewebstreifen eines vergrösserten Auswuchses mit dem Scalenus-Muskel und üben einen direkten Druck auf die Arteria subclavia aus.

Auf Grund von Nachuntersuchungen von 27 operierten Fällen von Scalenus-Syndrome, 7 mit, 20 ohne Halsrippen, erbringt der Verfasser den Beweis dafür, dass die Symptome in den vascu-

lären Fällen hauptsächlich auf direkten Verletzungen der Arterie beruhen, aber in gewissen Ausmasse auch durch Druck auf die vasomotorischen Sympaticusfäden, welche mit den kaudalen Plexuszweigen verlaufen, entstehen. Sowohl die neurologischen als auch die vasculären Symptome können durch obenbeschriebenen Mechanismus erklärt werden. Die neurologischen Fälle werden gewöhnlich durch Scalenotomie symptomfrei, während die Prognose in Fällen mit vasculären Symptomen, besonders wenn sie in Fällen mit Halsrippen auftreten, eine ungünstigere ist. Schmerzen lassen jedoch nach dieser Operation konstant nach.

Der Verfasser ist der Ansicht, dass vasculäre Symptome in Fällen von Scalenus-anticus-Syndrome unbedingt eine Operation erfordern, da das Risiko für eine Arterientrombose, welche in zwei von den besprochenen Fällen auftrat, nicht übersehen werden darf.

In drei Fällen hat die Injektion von Alkohol in Ganglion stellatum nach der Operation das Befinden der Patienten mit vasculären Symptomen erheblich verbessert.

### Résumé.

L'auteur a constaté la longueur relative de l'apophyse transverse du septième vertèbre cervical auprès plus de 400 roentgenogrammes de la colonne vertébrale cervicale. Il a trouvé que celle-ci était généralement plus longue dans les cas montrant les symptômes qu'on appelle le syndrome du scalène antérieur que dans les cas normaux. Ce fait a été démontré par une statistique dans ce travail. Ces variations peuvent être exprimées dans le chiffre-

$$\text{index} = \frac{\text{la longueur de l'apophyse transverse du septième vertèbre cervical} \cdot 100}{\text{la longueur de l'apophyse transverse du premier vertèbre thoracique}}$$

Etant donné que les dernières branches brachiales passent entre cette protubérance et le scalène antérieur l'auteur voit dans cette constatation non seulement une aide diagnostique mais aussi une cause importante pour la formation du syndrome du scalène antérieur. Les bandes de tissu conjonctif d'une protubérance agrandie ne convergent pas rarement avec le scalène antérieur et produisent une pression directe sur l'artère sous-clavière.

Basé sur examinations ultérieures de 27 cas opérés de ce syndrome (7 avec et 20 sans côte cervicale) l'auteur prouve que les symptômes dans les cas vasculaires sont formés spécialement sur les lésions directes de l'artère, mais ils doivent dans un certain degré aussi résulter de la pression sur les fibres vasomotens sympatiques, qui suivent les branches caudales du plexus brachial. Les symptômes neurologiques ainsi que les symptômes vasculaires s'expliquent par le mécanisme décrit plus haut.

La scalénotomie délivre généralement les cas neurologiques des symptômes, tandis que le pronostic est moins favorable dans les cas avec des symptômes vasculaires, spécialement s'ils se présentent dans des cas avec une côte cervicale. Quant aux douleurs elles diminuent toujours après cette opération.

Dans les cas du syndrome du scalène antérieur les symptômes vasculaires exigent, selon l'opinion de l'auteur, absolument une opération, car le risque d'une thrombose artérielle, qui s'était présentée dans deux des cas discutés, ne doit pas être négligé.

L'injection d'alcool dans le ganglion stellaire après l'opération a montré dans trois cas un effet très favorable dans l'état du malade avec des symptômes vasculaires.

The statistical calculations were made in the Statens Rasbiologiska Institute of Upsala. My thanks are due to Professor G. DAHLBERG, director of this institute, for his valuable aid and assistance.

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## Surgical Treatment of Pericarditis Constrictiva.

By

KAARE LIAVAAG.

Pericardiectomy as treatment for constrictive pericarditis was first recommended by DELORME in 1895. The first successful operation was performed by SAUERBRUCH and RIEN in 1913. Since then the operation has been done by several surgeons, and is now accepted as a well-grounded treatment which has its theoretical foundation in the patho-physiological conditions in constrictive pericarditis. The cardiolysis ad modum BRAUER (which previously was performed) has been abandoned, as this operation doesn't increase the diastolic refilling of the heart. This is the essential point in the operation, as all symptoms in this condition at an early period are caused by the decreased diastolic refilling of the heart. A better diastolic expansion can only be brought about by an operation which frees the heart from the thickened, rigid pericardium. The cardiolysis is supposed to be effective in cases with accretio pericardii. An accretio pericardii so extensive that the function of the heart is affected is seen only in cases where there is a constrictio as well. The cardiolysis as an isolated operation, therefore, has no indication, as it has no effect.

Previously most surgeons made an anterior incision. Costal cartilages and the adjacent parts of the ribs, so many as necessary, were resected with part of the sternum. When the pericardium is incised it is of great importance to get into the right layer. The pericardium can then often be stripped off easily by blunt dissection only. As SCHMIEDEN says, the pericardium is stripped off just as in peeling an orange, and not as in peeling an apple. How

much of the pericardium is to be resected has been a question of debate. SCHMIEDEN recommends leaving the pericardium over the atrium and auricles, but he considers it important to extirpate it at the entrance of the venae cavae. A local compression here is supposed in many cases to increase the symptoms. Others (SÖDERLUND, SETTERGREN) think that this is less important. That it in some cases is of great importance has been shown by CRAFOORD in one case operated upon by him. Most surgeons are of the opinion that the essential point in the operation is to extirpate the pericardium over the hardest working parts of the heart, especially the two ventricles.

Some surgeons operate under local anesthesia, and some under general anesthesia. Intratracheal narcosis undoubtedly is the best form of anesthesia. When the pericardium is stripped off, there is great risk of injuring the pleura. If such an injury is bilateral, the situation may be serious unless intratracheal narcosis with controlled respiration can be used.

Other complications are lesion of the coronary artery and perforation of the heart. Such perforation is most frequently seen over the atrium, and for this reason many surgeons recommend leaving the pericardium over the atrium untouched.

If an anterior incision is used, the wound should be drained for a day or two. Otherwise a haematoma often occurs, and this may cause some kind of heart tamponade.

Most surgeons recommend freeing the left ventricle first. If the right ventricle is freed first, it will be better filled in the diastole, but owing to lack of function of the left ventricle there will be stasis in the lungs. The right ventricle therefore cannot empty. Disturbance in the heart function will follow, and rupture of the right ventricle in such cases has been reported. In our material 8 patients have been operated upon through an anterior incision. One of the last patients was operated on through a leftsided intercostal incision, as is used for pneumectomy. This incision gave a very good approach to the heart, and the pericardium could be extirpated almost totally both over the front and back side. The operation could be done more radically than through an anterior incision. The approach to the entrance of the venae cavae was better through this incision too. Another advantage in using this incision is that the bony thoracic wall can be reconstructed after the operation. After an anterior incision there always will be a defect in the bony thoracic wall.

In the post-operative period the patient must be watched carefully. The decompensation often goes on for a long time after the operation. Continued treatment with diuretica and laparocentesis may be necessary. It is supposed by some, that in spite of the fact that there is no effect from digitalis in the preoperative period, this remedy is often effective in the postoperative period.

*Indications for operation:* As soon as the diagnosis constrictive pericarditis is made, the question of operative treatment should be discussed. In many cases the signs of constrictive pericarditis develop successively after a symptomfree interval. In such cases it is now recommended, especially by American surgeons (HARRINGTON et al.) to operate as early as possible. Otherwise there is great risk of irreversible injuries in the myocardium and other organs, especially the liver.

The more pronounced these changes are, the more risky the operation may be. The prospect of improvement after the operation will also be far less.

In those cases in which the constrictio develops after an acute pericarditis without any free interval, the question is more difficult. In such cases the operation ought to be delayed until all signs of active process have disappeared. This is especially to be remembered in all cases where there is any suspicion of tuberculosis. Cases of miliary tuberculosis directly following the operation in such conditions have been reported (IVANISSEVICH et al.).

In 1938 TENGWALL and INGVAR emphasized the fact that prognosis is more serious in cases where deposits of calcium are present than in others. They therefore rose the question whether deposits of calcium should be considered as contraindication to the operation. This view has not been maintained in recent years. Several cases with calcified pericardium have undergone successful pericardiectomies (HOLMES SELLORS, TUDOR EDWARDS, CRAWFORD, SETTERGREN, HOLST).

*Postoperative mortality:* PAESLER has collected 71 cases from the literature. 14 died immediately after the operation and 12 during the postoperative period. SCHMIEDEN has 21 cases. One died during the operation and 6 during the postoperative treatment. HARRINGTON has 6 postoperative deaths in 24 cases.

*Results:* The effect of the operation varies. In 1936 WESTERMANN collected 110 cases. Of these 22 were said to be cured, and 36 improved. HEUER and STEWART in 1939 collected 150 cases. 36 % were cured. As will be seen, the results are not ideal. The

results, however, are to be seen in light of the fact that operation is the only effective treatment which can be offered these patients. Furthermore, it is to be remembered that many of these patients have been operated upon in a late stage of the disease. The prospects of improvement are small in those cases as irreversible changes in the liver and other organs are present. Most likely the results may become better as the operative technique improves, and the operation is made at an earlier stage. At the Mayo Clinic 9 of 24 patients were cured after early operation.

In tuberculous cases the late results are supposed to be somewhat poorer than in the other cases. One of four in Harringtons material was cured.

In many quarters it is pointed out that a very long period often passes after the operation, before the decompensation is removed. HARRINGTON reports cases in which the decompensation continued for two years after the operation, and still the patients were cured.

### Material.

In Surgical Department A, 9 patients have been operated upon by Professor JOHAN HOLST, for constrictive pericarditis during the period 1937—1946. There were 6 men and 3 women. The ages were between 17 and 40 years. 6 patients were less than 30 years old. In other materials also most cases are found in the early age-groups.

In 6 cases the disease can be traced to a diagnosed acute pericarditis. In the other three cases the disease developed gradually, and the diagnosis pericarditis was not made before a chronic constrictive pericarditis was found.

Microscopic investigation of the pericardium removed has been done in five cases. In one of these the diagnosis tuberculosis was made. In the other cases fibrous tissue, with or without chronic, non specific inflammation was found.

At X-ray investigation a heart of normal size was found in three cases. In four cases the heart probably was a little enlarged, and in two cases a distinct enlargement of the heart was found. Deposits of calcium were found in two cases. Diminished amplitudes were found in all cases.

All patients showed on admission severe symptoms of heart decompensation, and they had all had protracted treatment ac-

according to the usual principles for treatment of this condition. This had only had a temporary effect. The most important clinical facts are to be seen from the following table:

Ascites .....	6 cases	
Edema of legs .....	6	"
Dyspnea .....	8	"
Cyanosis .....	6	"
Dilated veins in neck .....	8	"
Diminished pulsations .....	7	"
Calcified pericardium .....	2	"
Auricular fibrillation .....	1	"
Pleural effusion .....	3	"
Increased venous pressure .....	3	" (measured only in
Low blood pressure .....	3	" these cases)

In two cases (nr. 2 and 3) only cardiolytic was done. One of these patients died a few hours after the operation because of heart-failure. In the other case there was practically no effect from the operation. Pericardiectomy later was performed at another hospital. After this operation she was cured. In case nr. 9 cardiolytic was performed at another hospital without any effect, after pericardiectomy in our clinic some improvement followed. The material in this way confirms the accepted opinion that cardiolytic as an isolated operation is not indicated.

In the seven other cases partial pericardiectomy has been done. None of these patients died during the operation or during the postoperative treatment in the hospital.

In discussing the late results it is to be remembered that the term "cured" is not the same in all statistics. HARRINGTON considers as cured those who are fit for work. Instead of using the term "cured", we have divided the patients in two groups according to whether there has been any improvement after the operation or not.

In 4 cases the patients have been followed up for several years after the operation, viz. for 5 to 8 years. In one of these cases (nr. 4) the operation had no effect, and the patient died three years later. The cause of death was heart failure. Two are fit for work, one as a seamstress and one as a dentist technician, 8 and 5 years after the operation, respectively. Both are symptomfree, and they are using no medicine. The third works as a clerk. He was operated upon in January 1941. He was symptomfree from Janu-

ary 1944 to January 1945. He then had pulmonary disease, with fever and he once more had symptoms of heart failure. These disappeared after he had stayed in bed for four weeks.

In case nr. 5 and nr. 6 it was remarkable that the symptoms of heart failure continued for a long time after the operation, viz. 3 and  $3\frac{1}{2}$  years, and during this time the patients had to use diuretica. Even if the symptoms continue after the operation, the patient still can be cured. This should be emphasized more, as one otherwise is inclined to judge the results of the operation as poor, because attention is focussed only on the condition in the first period after the operation.

In the three others the follow-up-time is considerably shorter, as they were operated on in the years 1945—1946. Case 7, however, is practically symptomfree 6 months after the transpleural operation. Case 8 is improving steadily after the operation, and with the experience gained from the other cases, we have reason to believe that further improvement will follow, and that the patient perhaps may be cured. In case 8 the effect of the operation is doubtful. The ascites, however, has not been reproduced as rapidly after the operation. However, the follow-up-time is short, and as the venous pressure still is increased after the operation, it is doubtful that the effect of the operation will be satisfactory.

A summary of our results is as follows:

None of the 7 cases died during the operation or the postoperative treatment. In four cases there has been considerable improvement after the operation, to such an extent that these patients perhaps may be termed as cured, as three are fit for work, and the fourth has returned to his interrupted schooling. In one case there is constant improvement, but the patient still must use diuretica. The follow-up-time is only some months, so we have reason to believe that further improvement will follow. In one case there was no effect from the operation, and in one case it is doubtful that there will be any effect. The follow-up-time is short, however.

The case in which no effect of the operation was seen, was one of the cases in which a considerable enlargement of the heart was found before the operation. It is, of course, reasonable to suppose that the effect of the operation most likely will be best in those cases in which a normal size of the heart is found, and that the prospects of improvement are far less in those cases in which an enlargement of the heart is found. In these cases it must be sup-

posed that the constriction has developed in a heart which already was dilated, so that no more increase in the diastole can be expected after the operation.

Furthermore, it is to be noted that in some of the six cases in which the operation was performed through an anterior incision it has been very difficult to get a sufficient approach to the heart. In a couple of cases, therefore, only a small portion of the pericardium has been extirpated. Probably the effect of the operation might have been far better if it had been more radically. The case which improved most rapidly was case 7, in which a dorsolateral intercostal incision was used, and a radical extirpation of the pericardium was performed. This was in spite of the fact that this was a tuberculous case, and they usually have a poorer prognosis. Therefore, in the future we will use this incision and an intratracheal narcosis out of consideration both for the radicality of the operation and reconstruction of the thoracic wall after the operation. The same incision is used by CRAFOORD and several anglo-american surgeons (TUDOR-EDWARD, HOLMES-SELLORS).

As seen from the table, there were deposits of calcium in two cases. One of these died a few hours after the operation. In this case, however, only cardiolysis was done. If a pericardiectomy had been done, the heart function might have improved to such an extent that the patient perhaps could have survived the operation. At any rate, this postoperative death cannot be debited to the pericardiectomy operations. In the other case a considerable postoperative reaction followed, but otherwise the operation and postoperative period was without any complications. In our opinion, deposits of calcium are no contraindication to the operation. The same is seen from HARRINGTON's material in which deposits of calcium were present in 7 of 9 cured cases.

### Case Reports.

#### *Case 1. Marie L. J.nr. 10366/37.*

Woman aged 28. In the autumn of 1934 she had acute pericarditis. After a fortnight in bed she was symptomfree for one year. She then developed edema, ascites and dyspnea. In June 1937, she was admitted to Medical Department B. Edema, ascites and pleural effusion were found. There were dilated veins in neck. The liver was enlarged. There

was no enlargement of the heart. Ictus could not be felt. R.R. 120/70. X-ray of the heart: Diminished pulsations. Eeg.: Small amplitudes. She was treated with a low-salt diet and diuretica. She was well for a couple of months. Then she was again admitted to Medical Department. She now had a pronounced cyanosis. Renewed medical treatment had little effect. There was relapse as soon as the patient was out of bed. She was transferred to Surgical Department A, and <sup>10</sup>/<sub>11</sub> 1937 under ether narcosis the following was done: *Pericardiectomy partialis* (Prof. HOLST). An anterior incision was made. The third to sixth costal cartilages and the left half of the sternum were resected. There were very small pulsations of the left ventricle. The pulsations over the bases were larger. During the dissection a leftsided pneumothorax occurred. The pericardium was incised. The thickness was about 2 mm., and it was quite fibrous. It was easily stripped off almost the whole left ventricle. Over the right ventricle it could not be removed totally. The piece removed was 5 × 6 cm. The slit in the pleura was sutured. The wound was drained. In the postoperative period she developed empyema of the left lung. This had to be drained. After this she rapidly improved. Edema and ascites decreased, but did not disappear totally, so the patient had to use diuretica as before the operation. At follow up investigation in 1946, 8½ years after the operation, her physician gave the following informations: She is feeling quite well. She has no edema and no ascites. Some times after unusual exertion she has slight edema, but not embarrassing. She is using no medicine. She works as a seamstress.

### Case 2. Jenny A. J.nr. 1972/1940.

Woman aged 32. From January 1939 she had a pinching feeling in the precordium. She had dyspnea while working, and she had palpitations of the heart. In July 1939 she was admitted to Medical Department B, and pericarditis sicca was diagnosed. She was treated with salicylates and two months bed-rest, but she still had dyspnea, edema and slight cyanosis, and there were dilated veins in neck. R.R. 140/100. Cor: Ictus could not be felt. Abdomen: The liver was enlarged. Eeg.: Myopathia, small amplitudes. X-ray: Slight enlargement of the heart. Pleurocardial adhesions just above the apex. Diminished pulsations. No deposits of Ca. The edema did not disappear after medical treatment, and for this reason the patient was transferred to Surgical Department A. <sup>10</sup>/<sub>9</sub> 1940 under ether-narcosis: *Cardiolysis* (Prof. HOLST). An anterior incision was made. The fourth to eighth costal cartilages and adjacent parts of the ribs were resected. The pericardium was only slightly thickened. The heart moved up and down during the respiration. It was planned to perform the operation in two stages, and the pericardium was not incised. The wound was drained. Only a slight postoperative reaction followed. A temporary improvement followed, but after four months the condition was worse than before the operation. She now had ascites. She was treated with a low-salt diet and diuretica. This treatment had only a temporary effect. In the autumn



1942 she was operated on in another hospital, and pericardiectomy was done. After this operation she has been symptomfree. She is at work as a seamstress.

*Case 3. Torkil N. J.nr. 1214/1940.*

Man aged 40. In 1935 he had pneumonia in the right lung. In the winter of 1939 he had a severe cold with high fever. At the same time he had attacks of palpitation and dyspnea. He was in bed for  $2\frac{1}{2}$  months. In January 1940 he had new attacks of fever, palpitation and dyspnea, and the symptoms continued. On admittance  $20/8$  1940, he had edema. There were dilated veins in the neck. The pressure in vena cumbitalis was 320 mm. R.R. 120/90. Cor: Ictus could not be felt. Eg.: Diminished amplitudes. X-ray: Enlargement of the heart. Deposits of Ca. No pulsation over the right half of the heart. Diminished pulsations at the apex.

$23/8$  1940 under ether narcosis: *Cardiolysis* (Prof. HOLST). An anterior incision was made. The fourth to sixth costal cartilages and the adjacent parts of the ribs were resected. After the resection it appeared that there was a distinct inward movement of the freed soft part of the thoracic wall synchronized with the systole of the heart. The pericardium was not incised. Palpation disclosed that the pericardium was thickened and very hard because of deposits of Ca. During the operation a slit in the left pleura occurred. This was sutured. A few hours after the operation symptoms of failure of the function of the left half of the heart developed. In spite of stimulans and oxygen the patient died some hours after the operation. At autopsy a fibrous pericarditis with deposits of Ca was found. Stasis was found in all internal organs.

*Case 4. Esther E. J.nr. 1404/1940.*

Woman aged 30. In the autumn of 1938 she had pains in the precordium. She was in bed for a fortnight. In May 1939 precordial pains recurred. In July the same year edema and dyspnea appeared. She was treated with diuregan and laparocentesis. This had only temporary effect. She was admitted to Medical Department B.  $19/8$  1940. Status: There were dilated veins in the neck. Edema on the crura and thighs. R.R. 100/80. Cor: Ictus could not be felt. Abdomen: Large and distended because of ascites. Eg.: Myopathia, small amplitudes. X-ray: Enlargement of the heart. Diminished pulsations. Stasis in both lungs. Bilateral pleural effusion. The patient was treated with a low-salt diet and with diuregan and laparocentesis. This had only a temporary effect. She was transferred to Surgical Department A, and  $12/2$  1941 under intratracheal narcosis *Pericardiectomy partialis* (Prof. HOLST) was done. An anterior incision was made. The third to sixth costal cartilages were resected. A slit in the pleura on both sides occurred. The pericardium was thickened and hard. Pulsations of the heart could hardly be seen. The pericardium was incised and stripped off in front of both ventricles. The piece extirpated measured  $10 \times 8$  cm. The condition of the patient during the first phase of the operation was serious. As soon as the peri-

cardium was incised the condition got considerable better. The post-operative reaction was very slight. After the operation the edema and ascites persisted, and the patient was obliged to use diuretica as before the operation. She died in 1944. The cause of death was insufficiencia cordis.

*Case 5. Arnljot G. J.nr. 4286/1941.*

Man aged 22. In 1936 he had erythema nodosum and pleurisy of the left lung. Some months later pericarditis exsudativa developed. He was treated with punctions. Later he had bilateral pleural effusion and ascites. He was treated with thoracocentesis and laparocentesis. He was hospitalized for one year. There was some improvement, but later he got worse and became dyspneic. He was admitted to Medical Department B  $18/_{11}$  1940. Status: Slight cyanosis. Dilated veins in the neck. Edema on the crura. R.R. 120/90. Cor: Ictus could hardly be felt. Abdomen: Enlargement of the liver. Abdomen was large and distended because of ascites. Ecg.: Myopathia, small amplitudes.

X-ray: Symphysis pericardii, diminished amplitudes. No deposits of Ca. He was treated with a low-salt diet and diuretica. The effect was only temporary. He was transferred to Surgical Department A, and  $10/_{2}$  1941 under ether narcosis *Pericardiectomy partialis* (Prof. HOLST) was done. An anterior incision was made. The third to sixth costal cartilages and the adjacent parts of the ribs were resected. The pericardium was about 3 mm. thick. It was stripped off the front of the heart with but little bleeding, for the most part by blunt dissection. A piece, the size of a child's hand, was resected. The wound was drained. There were no complications in the postoperative period. A considerable improvement followed the operation. The edema and cyanosis disappeared, but when he was discharged  $18/_{4}$  1941 he still had ascites. The use of diuregan was continued until Dec. 1943. He then felt quite well and worked as a clerk. In January 1945 he had a febrile pulmonary disease, and after this he again had symptoms of insufficiencia cordis. At investigation in August 1945 he had edema but no ascites. The liver was enlarged. All symptoms of insufficiencia cordis disappeared after four week's bed-rest.

*Case 6. Arne H. J.nr. 6354/1941.*

Man aged 20. In 1937 he noticed the fact that he did not stand any great efforts, and he fainted during a sports achievement. In the year 1940 he developed dyspnea. He was admitted to Medical Department B  $5/_{11}$  1940. Status: Slight cyanosis. Dilated veins on the neck. R.R. 120/90. Cor: Ictus could not be felt. Abdomen: The liver was enlarged. The abdomen was enlarged and distended because of ascites. Ecg. Myopathia, small amplitudes. X-ray: Enlargement of the heart, deposits of Ca anterior to the right ventricle. Diminished pulsations. The patient was treated with a low-salt diet, diuregan and laparocentesis. There was no effect from the treatment, and later he developed edema. He was transferred to Surgical Department A, and  $15/_{2}$  1941, under

intratracheal narcosis *Pericardiectomy partialis* (Prof. HOLST) was done. An anterior incision was made. The third to sixth costal cartilages and the left half of the sternum were resected. A slit in the left pleura occurred. This was sutured. The pericardium was markedly thickened and hard. No pulsations of the heart could be seen. The pericardium was almost totally calcified and laying as a coat of mail around the heart. Anterior to both ventricles the pericardium could be stripped off comparatively easily, for the most part by blunt dissection. The extirpated piece measured  $10 \times 12$  cm. After the resection of the pericardium the pulsations became considerably larger, and the R.R. rose from 110 to 130. The wound was drained. In the postoperative period the temp. rose to  $39^{\circ}$  C. The patient was exhausted and had a rapid pulse. A haematoma developed in the wound. After this was emptied, the heart function improved considerably. However, he developed a bilateral pleural effusion, and the ascites increased. He was admitted to Medical Department B in Oct. 1941, and April 1943. At the time of both these investigations he had ascites, and he was treated with laparocentesis. In May 1943 he went to Sweden. In a letter in May 1946 he gave the following information: He continued to use diuregan until July 1944. Since then he has had no need for any medicine. He has no ascites and no edema. He is at work as a dentist technician.

*Case 7. Leif H. J.nr. 6455/1945.*

Man aged 17. In February 1944 he had pneumonia. He had a relapse twice, and developed a pericarditis exsudativa. He was treated in Vestfold Fylkessykehus. The diagnosis was pericarditis tuberculosa. In the autumn of 1944 he developed symptoms of insufficiencia cordis, viz. ascites and edema.

He was treated with a low-salt diet and diuregan. The venous pressure was 320 mm. As there was no effect from the medical treatment, the patient was transferred to Surgical Department A. Status: No edema. Dilated veins in the neck. R.R. 105/75. Cor: Ictus could not be felt. Abdomen: Large and distended because of ascites. Ecg.: Small amplitudes. Inverted T-waves. X-ray: Slight enlargement of the heart. Diminished pulsations. Right pleural effusion.  $^{10/12}$  1945 under intratracheal narcosis: *Pericardiectomy partialis* (Prof. HOLST). A left dorsolateral intercostal incision in 6 th. intercostal space was done. This incision gave a very good approach to the heart. The pericardium parietale was about one cm. thick. It was extirpated almost totally, and only a little remnant was left posteriorly. Pericardium viscerales was considerably thinner, but this too was stiff. It was extirpated over the left ventricle and practically over the whole front of the right ventricle and the atria. The wound was sutured airtight. A considerable postoperative reaction followed, and the temperature rose to  $40^{\circ}$  C. In a week the condition improved. The symptoms of insufficiencia cordis decreased. The pleural effusion disappeared. He left the hospital  $^{9/1}$  1946, at which time he still had ascites. Microscopic diagnosis was pericarditis tuberculosa in a fibrous stage. Follow-up-investigations in Vestfold Fylkessykehus in June 1946 showed considerable improve-

ment. He had no edema, no ascites and no dilated veins in the neck. He tired after unusual exertion. Otherwise he felt quite well. The venous pressure was 100 mm. He had taken up his interrupted schooling.

*Case 8. Olav T. J.nr. 1270/1945.*

Man aged 23. In Sept. 1939 he had pleurisy in the right lung. He was in bed for two months. In July 1940 he had bilateral pleurisy and pericarditis, and he developed ascites.

He was treated for two years in several provincial hospitals, whereafter he was admitted to Medical Department B. He was treated with a low-salt diet and diuretica. This had a temporary effect. In May 1943 he was operated upon for epididymitis tuberculosa. At the last admittance before operation in August 1945, the patient had palpitations and dyspnea on the slightest exertion. Status: Slight cyanosis. Considerable edema on the crura. Dilated veins in the neck. Cor: Ictus could not be felt. Abdomen: Large and distended because of ascites. The liver was enlarged: Ecg.: Myopathia. X-ray: Slight enlargement of the heart. Diminished pulsations. He was transferred to Surgical Department A, and <sup>23</sup>/<sub>8</sub> 1945 under ether narcosis *Pericardiectomy partialis* (Prof. HOLST) was done. An anterior incision was made. The third to fifth costal cartilages and the adjacent parts of the ribs were resected. Pulsation of the heart could hardly be seen. The pericardium was considerably thickened. It was comparatively easily stripped off the front of almost the whole heart. The pulsations of the heart got far better after the resection of the pericardium. Slits in both pleura occurred. These were sutured. In the first period after the operation the patient was considerably exhausted. He developed an axillary vein thrombosis. During the following months there was considerable improvement. He was discharged <sup>22</sup>/<sub>10</sub> 1945. He then had slight edema, and the ascites had decreased considerably. He was obliged, however, to continue the use of diuretica. At follow-up-investigation <sup>19</sup>/<sub>6</sub> 1945 there was no cyanosis, no edema and no ascites. The use of diuregan was discontinued, but he still used urea 15 gr.  $\times$  3 daily. In a letter in July 1946 he said that the improvement continued. He had no dyspnea now. Sometimes he had slight edema. The improvement was greatest in the last months.

*Case 9. Lars B. J.nr. 5873/1945.*

Man aged 17. In 1943 he had pleurisy in the left lung. In the autumn of 1944 he had exsudative pericarditis. He was treated with punctions. He developed symptoms of insufficiencia cordis viz. enlargement of the liver, ascites, edema and dilated veins in the neck. In April 1945 in another hospital a cardiolysis was done. There was no effect from this operation. He was admitted to Medical Department B in Nov. 1945. Status: Slight cyanosis. Edema of the crura. Dilated veins in the neck. The venous pressure was 260 mm. R.R. 105/60. Abdomen: Large and distended because of ascites. Ecg.: Myopathia, small amplitudes. X-ray: No enlargement of the heart. Diminished pulsations. He was

treated with a low-salt diet, diuregan and laparocentesis. The treatment had no effect. He was transferred to Surgical Department A, and <sup>29</sup>/<sub>1</sub> 1946 under intratracheal ether narcosis *Pericardiectomy partialis* (Prof. HOLST) was done. An anterior incision was made. There were considerable adhesions between the scar and the pericardium. The pericardium was thickened and hard. The thickness was about 3—4 mm. It was stripped off the front of almost the whole heart, for the most part by blunt dissection only. A tear in the right pleura occurred. This was sutured. The wound was drained. After the operation he constantly had edema and ascites and had to be treated with diuretica and laparocentesis as before the operation. The reproduction of the ascites, however, was slower than before the operation. He was discharged <sup>7</sup>/<sub>5</sub> 46. The condition was not far better than before the operation. The venous pressure still was 260 mm.

### Summary.

The author reports on the surgical treatment of 9 cases of pericarditis constrictiva. Cardiolysis was done in two cases. One of these died a few hours after the operation. In the surviving case there was no effect from the operation. In seven cases pericardiectomy partialis was performed. There was no postoperative death. In four cases a considerable improvement followed the operation. All these patients are fit for work, and are practically symptom-free. In three of these cases the period of observation is long, viz. 5 to 8 years. In the fourth case it is only some months. In one of the three remaining cases the result may be good, but the period of observation is too short. In one case it is doubtful that any effect will follow the operation, and in one case the operation had no effect. This patient died three years after the operation. It is recommended that the operation is performed under intratracheal narcosis and that a dorsolateral transpleural incision is used, as this gives a good approach to the heart, and the thoracic wall can be reconstructed after the operation. It is furthermore recommended to operate at an sufficiently early stage in the disease before irreversible changes in the liver and myocardium have occurred.

### Zusammenfassung.

Der Verfasser berichtet über die chirurgische Behandlung von 9 Fällen von Pericarditis constrictiva. In 2 Fällen wurde Cardiolyse ausgeführt. Der eine Patient starb wenige Stunden nach

der Operation. In dem anderen Fall war die Operation ohne Wirkung. Pericardiectomy partialis wurde in sieben Fällen ausgeführt. Es war kein Todesfall. Eine beträchtliche Verbesserung wurde in vier Fällen beobachtet. Alle diese sind arbeitsfähig, und sie sind fast symptomlos. Drei von diesen Fällen sind in 5 bis 8 Jahre nach der Operation beobachtet worden, während ein Fall nur einige Monaten nach der Operation beobachtet ist. In einem Fall möchte das Resultat gut werden. Die Beobachtungszeit ist doch sehr kurz. In einem Fall ist es zweifelhaft ob die Operation wirkungsvoll wird, und in einem Fall war die Operation ohne Wirkung. Dieser Patient starb 3 Jahre nach der Operation. Es wird empfohlen die Operation durch einen dorsolateralen transthoracalen Schnitt in intratrachealer Narcose auszuführen, als dieser Schnitt einen guten Zugang zum Herz gibt, und der Brustwand nach der Operation rekonstruiert werden kann. Es wird weiter empfohlen in einem frühen Stadium zu operieren, ehe dauernde Veränderungen im Leber und Myocardium entstanden sind.

### Résumé.

L'auteur fait rapport du traitement de neuf cas de péricardite constrictive. Deux malades ont subi une cardiolyse. L'un est mort quelques heures après l'opération, et chez l'autre l'opération n'a eu aucun effet. Sept malades ont été soumis à une péricardectomie partielle, et personne n'est mort à cause de l'opération. Chez quatre malades l'opération était suivie par une amélioration considérable. Ils sont tous capables de travailler, et n'ont pas de troubles. Dans trois cas la période d'observation est assez longue, de cinq à huit ans. Dans un quatrième cas elle n'est que quelques mois. Chez un malade le résultat sera vraisemblablement bon, mais à présent le temps d'observation est trop court. Dans un cas il semble douteux si l'opération aura de l'effet, et dans un autre elle n'en avait pas. Ce dernier malade est mort trois ans après l'opération. Il est recommandé d'opérer sous anesthésie générale intratrachéale, et de se servir d'une incision dorsolatérale transpleurale. Cette voie d'abord donne un bon accès au cœur, et permet de refaire la paroi du thorax après l'opération. Il est aussi recommandé d'opérer dans un stade peu avancé de la maladie, avant que des altérations irréversibles du foie et du myocarde ne soient développées.

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## Subcutaneous Rupture of the Tendon of the Tibialis Anterior Muscle.

By

ERIK MOBERG.

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In 1928 BRÜNING described two cases of rupture of the tendon of the m. tibialis anticus, and in 1934, in connexion with the publication of another two cases, BURMAN gave a good description of the injury, its diagnosis and treatment. These cases are briefly reviewed below as No. 1 and No. 2 (BRÜNING) and No. 3 and No. 4 (BURMAN).

*Case 1. Man, aged 69 years.* Trauma one year earlier as a result of an automobile wheel running over his foot. Only mild trouble arose and this rapidly receded. No complaint until one year after this trauma, when sudden pains without observable external cause arose in the same foot at the attachment to the tibialis anticus. The symptoms subsided after a few minutes. One week later a hasty movement was followed by a sudden pain in his foot as if something had broken off. The pain passed off after 10 minutes, but he could then only walk with difficulty and caution. After another week there was a mild, indirect trauma followed by the same pain, after which he consulted a physician. The tibialis anterior tendon could not be felt in its proper place. Dorsal flexion  $15^{\circ}$  less than on other foot. Conservative treatment with fixation in dorsiflexed position. The injury healed under this treatment so that the pains only appeared when he made missteps or was walking on uneven ground. The tendon of the tibialis was still missing from its proper place. Shortly afterwards the patient died of heart attack.

*Case 2. Man, aged 48.* Kicked at an object and immediately had a sensation of "dropping of the foot", followed by a feeling of weakness. Swelling, no notable pain. Operation a week later showed that the tendon was torn off in its substance at about the level of the lower margin of the annular ligament. Suture. Fixation in plaster. Full normal function of the foot was obtained as a final result.



*Case 3. Man, aged 45 years.* Fell when ski-ing, with his foot in plantar flexion. At operation, signs were seen of an old haemorrhage in the tendon. Suture. Complete restoration.

*Case 4. Man, aged 25 years.* Great violence in direction of maximum plantar flexion. All the toes were dislocated dorsally and anterior tibialis was torn off with a small fragment of bone at the attachment, which prevented retraction of the tendon. Conservative treatment and an arch support gave a good result.

The author has been unable to find more reports of this injury than these, but has himself observed another four cases, reported below as Nos. 5 to 8. Two of these are operatively verified and the patients have been restored to health by surgical means.

*Case 5.<sup>1</sup> Man, aged 50 years.* Police man. Seven weeks before admission the patient slipped, fell, and caught his right foot under him in such a way that it was in maximum plantar flexion. In spite of considerable immediate pains he was able to get up and walk without aid a couple of hundred metres to his home. Immediately a pronounced swelling appeared anteriorly over the ankle-joint, where discoloration arose and spread down the medial side of the foot. The patient kept quiet indoors a couple of days, but soon started work again, in the course of which, however, he was troubled by a considerable swelling round the ankle, a feeling of weakness in the foot and stiffness in the ankle. Three weeks after the first accident he slipped again and had increased trouble in movement and increased swelling over the front of the ankle-joint. Since then he had been unsteady in his ankle and felt stiff and weak in the ankle-joint. On examination the absence was noticed of the normal outline of the tibialis tendon. The tendon could not be palpated in its proper place, but a few centimetres above the ankle at the same place a mildly tender resistance, fully the size of a hazel-nut, could be felt. Immediately below this there was noticed a depression. Dorsal extension of the foot was possible to a not quite normal extent, but the gross power was considerably lower than on the other side. X-ray examination showed no bony changes.

As the patient's symptoms were rather mild and his ability to walk was not notably reduced, he preferred a trial with conservative treatment to the suturing of the tendon proposed as an alternative. A letter from the patient three years after the trauma states that the foot has gradually become so restored without surgical treatment that practically no trouble remains. The patient can walk and run as normally.

*Case 6.<sup>1</sup> Lorry Driver, aged 46 years.* Eight years before being examined the patient's right foot had been subject to direct trauma through a couple of heavy iron girders falling on it. A transverse fracture arose

<sup>1</sup> The case was observed 1911 by the author at the Vanförcenstalt (Cripples' Institute) in Stockholm (Former Chief: Professor H. WALDENSTRÖM).

through the base of the third metatarsal bone, though there was no considerable dislocation. In addition a small corner close to the proximal joint-surface on the first metatarsal bone was torn away. After fixation of the foot in plaster of Paris for two weeks, followed by relief of the pressure by means of an arch support the patient was so improved that he could be fully at work. He had stopped using the arch support. At an examination for another affection the patient stated that he could not stand on the heel of his right foot, and further complained of some fatigue under the arch of the foot.

On examination the tendon sheath enclosing the lower part of the tibial tendon was felt to be empty. The muscular power on dorsiflexion of right foot did not amount to more than one-third of that on the left side, while the range of movement was only slightly less. On account of the slight symptoms and the age of the patient surgical measures were not considered to be indicated.

*Case 7. Bank Official, 46 years.* One month before admission the patient caught his heel on a staircase and slipped. He then felt a lightning-like pain in his left foot, and a swelling quickly arose on the uppermost part of the dorsum. The symptoms were otherwise insignificant. Since then, however, the foot had clamped when the patient was walking because he "could not lift his toes".

At the examination a defect was felt in the tibialis anterior tendon at the level of the malleoli. The muscular power in dorsiflexion was greatly reduced. This movement could be carried out only with the toes in active superextension. On operation (under spinal anaesthesia) it was found that about one centimeter from its insertion the tendon was torn away and was connected with its insertion point by only a few thin overstretched fibres. From a functional point of view there was thus a complete break in continuity. The drawn-up tendon could be sutured with silk to the distal fragment and the adjoining periosteum. This was followed by fixation of the foot in plaster for seven weeks in mild dorsiflexion. Good function was obtained, but the range of movement and muscular power in dorsiflexion is still reduced.

*Case 8. Building Joiner, aged 62 years.* On day of admission his heel had caught when he was walking downstairs, his foot thereupon coming with a jerk in a position of great superflexion. Severe pains immediately arose, but these passed off in about 10 minutes, after which the patient was able to walk again. He noticed, however, that his foot snapped at every step and that its power of dorsiflexion was bad. The patient consulted a practitioner (Dr. G. VIEWIG), who sent in the patient under a complete and accurate diagnosis. On examination, the normal outline of the tibialis tendon could not be observed and the tendon sheath felt empty from the ligament down to the attachment. There were only a slight swelling and but very little tenderness. The power of extension in the ankle-joint was much restricted.

On operation the tendon was found to be entirely torn off immediately above its attachment, and the proximal stump was retracted a few cen-

timetres. The tendon-ends were fibrously frayed. Exeision was performed for histological examination. The tendon was sutured to its attachment with silk. After suture of the skin the foot was fixed in plaster in slight dorsiflexion for six weeks. Histological examination showed degenerative changes in the tendon, in part mucoid degeneration (FORSSELIUS).

The function of the foot was completely restored, and the patient was at work 14 weeks later.

Table.

Case	Age	Trauma	Therapy	Residual symptoms
1	69	Several minor	Conservative	mild
2	48	Kick with foot	Suture of tendon	0
3	45	Caught foot while skiing	Suture of tendon	0
4	25	Violent trauma, foot dragged after locomotive	Conservative	0
5	50	Slipped	Conservative	0
6	38	Blow from falling iron girder	Conservative	mild
7	46	Heel caught	Suture of tendon	mild
8	62	Heel caught	Suture of tendon	0

All the known cases have thus reference to men. Rupture of the tendon itself has only occurred in middle-aged and elderly men. In case 4, a young man, the bone attachment of the tendon was torn off instead. In case 6, a somewhat younger man, the violence was direct. In the other cases the violence was indirect and in several astonishingly slight. As a rule the violence consisted of a considerable superflexion of the foot plantarly, doubtless as a rule combined with a powerful contraction as response of the muscle. In a case or two the rupture evidently took place partially and in stages from very slight traumata, a method of rupture that is well known from, for instance, the corresponding subcutaneous ruptures of the achilles tendon.

ELS has shown in experiments on cadavers that a normal tibialis tendon does not allow itself to be torn off. The cases reported above also indicate that true rupture of the tendon only occurs in tendon tissue of reduced strength, *i. e.* at a somewhat advanced age or after earlier trauma (case 1). In one case (8) histological examination confirmed the assumed degeneration in the tendon. Thus, the conditions are entirely analogous with those in ruptures of the tendon of the supraspinatus in the shoulder (CODMAN, LINDBLOM).

The ruptures of the tendon are localized to the passage under

the crucial ligament. On examination immediately after the injury, if the patient tries to tense the tendon, the normally distinctly visible and easily palpable outline of the tendon does not appear at all. Sometimes the site of the rupture itself can be felt.

The immediate symptoms are astonishingly small and very transient. Walking ability is not lost as a rule. Local haemorrhage and swelling are often minimum. The foot cannot, however, be lifted properly on walking but may fall down into a *pes equinus*.

Secondarily, too, the loss of mobility is not great, and it seems as though no considerable loss of function is to be expected from the injury unless special demands are placed on the foot. Some restriction in movement, reduced strength and secondary *pes planus* will be the ultimate result. The conservatively treated cases show this quite clearly. This is presumably attributable to the fact that the function of the muscle can be replaced to an essential extent by the powerful toe extensors.

Thus, the loss of the tibialis function through a trauma of this kind by no means causes such inconveniences as are brought about by a loss of muscular function through a poliomyelitis. The reason for this, of course, is that the injury caused by the latter affection is extremely seldom confined solely to the muscle mentioned but also involves more or less paresis of the other anterior muscles of the lower leg.

In spite of the relatively good results shown by conservative treatment a suture of the tendon is doubtless desirable unless surgical interference is contra-indicated, as restoration seems to be more rapid and effective and the operation seems to involve but very small risk. In cases where prolonged retraction of the tendon has developed so strong a muscular contracture that the tendon-ends cannot be brought together the diastasis can doubtless be bridged over with the aid of the tendon of the extensor hallucis longus, the stump of the proximal tibialis being sewn to the tendon mentioned and the hallucis tendon divided at the dorsum, whereupon the proximal stump of the external hallucis is drawn down to the attachment point of the tibialis anticus through the tibialis sheath in the ligamentum cruciatum and is here fixed under dorsal extension in a groove chiselled in the bone. The distal portion of the extensor hallucis can be connected to the tendon of the long extensor of the second toe. This operative method has been used with success by the author in a case of inveterate severance of the tibialis anticus caused by a complicated fracture of the lower leg.

Rupture of the tendon of the tibialis anterior in the foot thus seems to be both a rare and not very serious injury. None the less, it is of interest as a link in the important detailed diagnosis of those injuries in the ankle region which only too often (just as in corresponding cases of the shoulder joint) are dismissed with the uninforming diagnosis "distorsio" with its attendant schematic therapy, instead of being analysed into its various forms, each of which requires its special effective treatment.

### Summary.

Four cases of subcutaneous rupture of the tendon of the tibialis anterior in the foot are described, two of which were operated on, while the two others were treated conservatively. Four cases previously published are reviewed. Evidently this rare rupture takes place only in connexion with earlier pathological changes in the tendon.

### Zusammenfassung.

Der Verfasser legt vier Fälle von subcutaner Zerreissung der Sehne des *Musc. tibialis anterior* vor. Zwei von diesen sind mit Operation, zwei dagegen ohne solche behandelt worden. Noch vier Fälle der Literatur werden erwähnt. Diese seltene Zerreissung scheint nur bei pathologischen Veränderung an der Sehne stattzufinden.

### Résumé.

L'auteur décrit quatre cas de rupture des tendons du muscle tibial antérieur du pied, dont deux ont été opérés avec succès tandis que les deux autres ont été traités sans opération, le premier avec un résultat entièrement bon, l'autre avec très peu de détriment restant. Quatre cas publiés auparavant sont référés. Il est évident que cette rupture peu commune ne se présente que quand il existe déjà des changements pathologiques au tendon en question.

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## Cancer of the Colon and a Detail of Operative Technique.

By

RUDOLF BRANDBERG and TORE EKBLOM.

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On perusal of the literature pertaining to cancer of the colon, one finds that a palpable improvement has been achieved in the results of treatment during the last decade. A trend is apparent towards numerical increase of operable cases, and towards a reduced operation mortality. As the most important factors for the latter can be quoted: improved methods of anaesthetization and operative procedure, careful pre-operative management, and material advances in the prevention of conditions due to post-operative shock and infection. However, where the surgery of colonic cancer is concerned a considerable operative death rate must be taken into account, as the patients to be subjected to operation consist largely of older individuals with impaired general condition, "flabby" obesity, diseased organs of circulation etc.; they are, in other words, often distinctly unfit for surgical intervention.

For colonic surgery in general the following facts regarding this part of the intestinal tract are of decisive significance:

1. The wall of the colon is *comparatively thin* and particularly deficient in the constituent most essential for suturing, viz. the musculature. The removal, for the purpose of placing sutures, of the epiploic appendages and other structures of adipose tissue, results in a more or less *impaired blood supply* to the divided ends of the bowel.

2. A plentiful *flora of virulent bacteria* is continually present in the colon. The chemotherapeutics hitherto available exert only a moderate inhibitory action on the bacteria in question. Thus, in the case of colonic resection a much more serious infection risk has to be taken into account than when dealing with any other part of the intestinal tract.

3. The colon is a *distinct depot organ*, and the difficulties of completely emptying a normal colon by purging or enemata are overwhelming. With pathological processes entailing restricted passage or obstruction, complete evacuation of the colon not infrequently proves quite impossible, even after procedures in order to establish decompression. Consequently, one is now and again compelled to operate on a more or less filled colon.

Whereas the above circumstances constitute definite disadvantages, a distinctly favourable fact is that a complete fistula can be made wherever desirable in the colon, without occasioning disturbances of the nutrition, or of the fluid and salt balances. Only the caecum, as was shown by BRANDBERG, constitutes under certain conditions an exception to this rule. By the establishment of such a fistula the desired portions of the colon can be excluded from the faecal current, and the difficulties specified above can thus be counteracted, but by no means completely overcome.

*Ileocecal resection* may, as regards operation risks, on theoretical grounds be stated to range right between resection of the small bowel and colonic resection. The procedure does not implicate any special problems from technical or other points of view. The fact that it nevertheless carries a considerable mortality can be attributed principally to the unsatisfactory condition of the patients to be operated upon, not to imperfect operative technique. Fatalities owing to post-operative peritonitis and similar complications are comparatively rare.

The procedures for removing the caecum and ascending colon, that have to be taken in consideration besides of primary ileocecal resection, are the following:

1. *Multiple-stage resection according to Bloch-Mikulicz*, favoured particularly in American quarters, by LAHEY *et al.*, even for resection of the right colon. In this operation the nethermost portion of the ileum is mobilized in order to form the proximal loop of the exteriorized bowel. The procedure does thus not achieve less impairment to the patient than does ileocecal resection, nor has it apparently brought about an appreciable decrease in the death rate.

gives little pain to the patient and can be done without anaesthesia. The closure of the colostomy is conveniently carried out under simple local anaesthesia. Neither can the fact that the various procedures have to be spread over a fairly long period, sometimes ranging from 2 to 3 months, possibly be regarded as a more serious drawback. It is often stated that by the Bloch-Mikulicz method the mesocolon with the glandular metastases situated there might be less effectively removed than by primary resection. This contention is clearly erroneous. The removal of a mesocolon is not a procedure inseparably connected with the method of resection adopted, but constitutes a fairly independent technical detail. The real disadvantage of the Bloch-Mikulicz multiple-stage operation lies in the fact that it can be employed only if on either side of the affected area loops can be formed of sufficient length for exteriorization. Consequently, it cannot be used in the nethermost portion of the sigmoid flexure and in the pelvic colon. If it is intended to employ the Bloch-Mikulicz procedure for a tumour situated in the caecum and proximal portion of the ascending colon, the proximal loop of the exteriorized bowel should consist of the terminal part of the ileum. This is an obvious disadvantage. Where obese subjects are concerned the Bloch-Mikulicz procedure often proves difficult on account of the ample fat deposit in the abdominal wall.

*One-stage resection of the colon*, possibly subsequent to the formation of a relieving fistula, is clearly the most reasonable and appropriate procedure; only the disadvantages of this operation have led to other methods of resection being introduced and approved. Attempts to restrain, by technical measures, the consequences of leakage after one-stage resection have not been lacking. Thus, BABCOCK uses a glass tube shaped like a lamp-glass, which is inserted towards the site of resection, or else special glass aspirators connected with various suction contrivances. With this technique he had a mortality of 18 per cent among 252 operated cases, whereas after one-stage anastomosis without special precautions 9 fatalities out of 26 were noted (death rate, 35 per cent). — DECKER tried to separate the site of resection from the rest of the peritoneal cavity by packing gauze around the former. When sufficient demarcating adhesions had formed after some time, the packing was removed. DECKER reports on a series of 17 cases treated in this way, with 2 fatalities



from pneumonia and pulmonary embolism respectively. In 6 cases a faecal fistula developed in the site of resection, which however soon closed spontaneously. By the method adopted DECKER was able to prevent peritonitis.

From 1940 onwards we have used at the surgical department of Södersjukhuset another method, employed by BRANDBERG for some years, in order to separate the site of resection from the peritoneal cavity. The procedure is remarkably simple and adds only a few minutes to the time required for operation. On resection for tumour or other conditions of the descending colon, the site of operation is separated from the rest of the peritoneal cavity, after open resection performed in the ordinary way with end-to-end anastomosis, by suturing the peritoneum on to, or over, the resection margins, and the peritoneal cavity thus formed is drained. When operating on the descending colon and the sigmoid flexure, the parietal peritoneum from the median part of the incision wound is affixed to the median and anterior aspects of the intestine, and the suture is continued upward and downward until the lateral wall of the abdomen has been reached. In this way the entire area of resection can be separated without difficulty from the rest of the intra-abdominal space; the cavity is drained through the incision wound.

When resecting the nethermost portion of the sigmoid flexure and the pelvic colon, the site of resection is attached by sutures beneath the peritoneum in the fossa Douglasi, and the cavity thus formed is drained extraperitoneally. In the majority of cases this is most conveniently done by establishing a tunnel-shaped communication with the lower angle of the abdominal wound (median incision). In other instances it can be of advantage to direct the extraperitoneal tunnel towards the left iliac fossa, and to let it run out into a small supplementary incision in this region.

The separation measures detailed above prove entirely satisfactory safeguards against peritonitis. In several instances we have observed considerable septic discharge from the site of operation, in some cases even faecal fistulae, without any reaction whatsoever from the peritoneal cavity. The infection has as a rule subsided within a short period, and all the faecal fistulae have very soon closed spontaneously. No obstruction due to the affixture of peritoneum was ever noted.

However, separation of the site of resection is practicable

only in the left portion of the colon; but this is notoriously the region in which most of the colonic cancers are found. In our opinion, the method is of definite value.

In cases of tumours involving the caecum, ascending colon and hepatic flexure, we recommend primary ileocecal resection. For the rather rare tumours of the transverse colon, multiple-stage resection according to Bloch-Mikulicz might be considered the most appropriate procedure.

Our material of colonic cancer, comprising all the cases treated from May 1st, 1940 to April 30th, 1946 is not particularly comprehensive as compared with certain foreign series, but it allows of comparison with previous Swedish surveys.

In all, 107 cases of colonic cancer were hospitalized during that period. Our colonic cancer patients frequently arrive at the hospital in poor condition, depending on the fact that to a very large extent we have to admit the clientele of the nearby municipal homes for the aged and other charitable institutions.

Further, in our series the average age is comparatively high, as will be seen from Table 1. 75 patients, *i. e.* 70 per cent, were more than 60, and about 30 per cent more than 70 years of age. PAUS quotes 35 to 40 per cent between 61 and 70 years, FINSTERER about 45 per cent over 60 years, CATTEL 10 per cent over 70 years, and JOHNSON (Lund) had 65 per cent over 60 years. — The advanced age of the colonic cancer patients entails a considerable incidence of concurrent diseases, and the resistance of those patients to surgical intervention is accordingly decreased; however, in many quarters, *inter alia* by FINSTERER and ADAMS, it has been emphasized that few patients are too old or too feeble for operation. This as a rule has also been the principle followed by us, if the tumour could be considered to be operable. In our series, serious concurrent diseases, *e. g.* cerebrospinal syphilis, cerebral thrombosis, gangrene of the foot, grave cirrhosis of the liver, and cancer in other organs, were present in 11 cases, *i. e.* 10 per cent.

The *operability* is to a high degree affected by the duration of the condition prior to admission. It has always been a desideratum that the diagnosis should be established as early as possible. However, in this respect no progress whatsoever seems to have been made in our country for the last few years, at least according to the evidence afforded by our material. Table 2 shows the condition of the patients immediately on admission. Thus, 58 cases

Table 1.  
*Age Incidence.*

	Under 50 Y.	50—60 Y.	61—70 Y.	71—80 Y.	Over 80 Y.	Total
No. of cases hospitalized for cancer of the colon.	16	15	44	26	6	107
Of these, resected .....	12	9	25	14	3	63
Deaths after resection ....	1	0	4	3	0	8

were admitted at far advanced stages. — As revealed by Table 2, in our series comprising 107 cases, 16 patients were admitted with perforation (peritonitis or abscess), 13 displayed evident metastases (liver metastases, ascites), and 29 suffered from acute ileus.

Table 2.  
*Condition on Admission.*

	General con- dition com- paratively satisfactory or impaired, but without complications demonstrable on admission	Acute ileus	Perfo- ration (peri- tonitis or ab- scess)	Metastases (palpable liver metastases, ascites)	Various con- current dis- eases (cere- bral throm- bosis, grave hepatic cirrhosis, gangrene of the foot, can- cer of other organs, etc.)	Total
No. of cases hospitalized ..	38	29	16	13	11	107
Of these, re- sected .....	32	23	2	2	4	63
Deaths during hospitalization	2	5	11	4	4	26
Of these, after resection .....	2	4	0	0	2	8

In cases with diffuse faecal peritonitis the condition is notoriously hopeless, but when dealing with abscess formation we carried out resection in 2 cases, both with favourable results. We performed resection in 3 cases in spite of evident metastases, and all the patients endured the operation well. The presence of less extensive metastases in the liver or in the lymph nodes adjacent to the aorta does not argue against the removal of an otherwise operable tumour. Symptoms of intestinal obstruction, haemorrhage, absorption via the usually ulcerated growth, etc. are pre-

vented by the resection; moreover, it stands to reason that the operation is apt to exert a favourable influence on the psyche of the patient. The patients may, at least sometimes, be afforded some few years of comparative comfort.

Ileus associated with cancer of the colon is supposed to affect the prognosis very unfavourably. In addition to our 29 cases of acute ileus, there were 32 cases of subileus or chronic obstruction; symptoms of ileus thus occurred in 61 instances, *i. e.* 57 per cent. In more extensive surveys the incidence of ileus is usually stated to range from a quarter to one-half of the cases. According to WANGENSTEEN, acute or chronic ileus is present in one-third of the cases of colonic cancer. To quote some figures, KÖRTE reports 39 per cent, BURGESS 38 per cent, SÖDERLUND about 30 per cent, JOHNSON (Lund) 17 per cent cases of acute ileus.

Resection procedures during the stage of ileus seem at present to be generally disfavoured, although there are exponents of this management in suitable cases, *e. g.* VON HABERER. The majority of the authors advise a relieving fistula prior to resection. — On the other hand, there are certain cases in which primary resection will prove beneficial, *viz.* those of stenosing tumours situated in the free loop of the sigmoid; this loop can easily be exteriorized according to BLOCH-MIKULICZ and immediately divided with the cautery, a wide tube then being passed into the proximal portion. We have operated 3 cancers of the sigmoid by this method, all of them with satisfactory results. — In other cases of ileus a relieving fistula (caecostomy or colostomy) was made immediately, resection being performed after some time, provided the tumour was found to be otherwise operable. Among the 61 cases of ileus 32 could be subjected to resection, with 5 deaths.

The site incidence of the tumours with regard to the different parts of the colon (see Table 3) is that commonly noted, *viz.* 20 to 25 per cent in the caecum and ascending colon, less than 10 per cent in the transverse colon, slightly more than 10 per cent in the descending colon, and 55 to 60 per cent in the sigmoid.

In our series of 107 colonic cancers, we were able to perform some type of resection procedure in 63 cases. Thus, the operability rate (see Table 4) is about 59 per cent, a comparatively high figure having regard to the unsatisfactory material. In a comprehensive statistical survey by OCHSNER-DE BAKEY (1939) comprising 4,561 cases, the rate of operability amounted to 58.5 per cent. Otherwise the figures vary considerably in different reviews, *viz.*

Table 3.

*Seats of Colonic Cancer and Incidence of Ileus Symptoms.*

	Cæcum and ascending colon	Transverse colon	Descending colon	Sigmoid	Total
No. of cases hospitalized .....	26	6	15	60	107
Of these, with ileus symptoms (acute or subchronic) .....	10	5	11	35	61

from slightly more than 30 up to 94 per cent (ALLEN, 1943). CRAFOORD (1934) quotes 79 per cent, PETRÉN (1928) 58 per cent, SÖDERLUND (1933) 54 per cent, and JOHNSON (1943) 48 per cent. Rather illuminating are some figures given by ZINNINGER (1943) from Cincinnati, a city possessing two large hospitals, one general and one private; in the general hospital, the operability rate was 52 per cent, and in the private, 91 per cent. Evidently those high figures must relate to very selected materials.

Table 4.

*Operability.*

	Cæcum and ascending colon	Transverse colon	Descending colon	Sigmoid	Total
No. of cases hospitalized .....	26	6	15	60	107
Of these, deaths during hospitalization .....	5	3	1	17	26
Resections .....	21	4	11	27	63
Of these, deaths .....	4	1	0	3	8
Palliative operations ..	4	1	3	20	28
Of these, deaths .....	0	1	1	6	8
Not operated (declined operation) .....				3	3
Inoperable .....	1	1	1	10	13
Of these, deaths .....	1	1		8	10

Of our 63 patients subjected to radical operation, 8 died during hospitalization (Table 5). We have thus a primary operation mortality of 13 per cent. As to the various resection methods, the results are as follows: 21 ileocaecal resections with 4 deaths, mortality 19 per cent; 14 resections according to BLOCH-MIKULICZ with 1 death, mortality 7 per cent; and 28 one-stage resections

Table 5.  
*Types of Resection.*

	No. of cases	Deaths during hospitalization
Ileocaecal resection + ileotransversostomy . . . . .	21	4
Colonic resection + end-to-end anastomosis . . . . .	5	1
Colonic resection + end-to-end anastomosis + peritoneal separation of the resection site . . . . .	23	2
Multiple-stage resection of Bloch-Mikulicz . . . . .	14	1
Total	63	8

with end-to-end anastomosis, with 3 deaths, mortality 11 per cent. — Consequently, we have a total death rate of resections for right tumour of 19 per cent, and for left tumour of about 10 per cent. As a rule, the mortality is stated to be higher for resection of left tumour; OCHSNER-DE BAKEY (1939) reviewing 719 cases give the mortality rates of 19.6 for right and 24.4 per cent for left tumours, and 21.7 per cent as the total mortality for 2,991 resections. SÖDERLUND (1933) quotes 18 per cent mortality for right and 28 per cent for left tumour, CRAFOORD (1934) 18 per cent for tumour in the caecum and ascending colon, 29 per cent in the transverse colon, 37 per cent in the descending colon, and 42 per cent in the sigmoid. In our series, the deaths after ileocaecal resection were caused by complications from the upper respiratory tract, heart and kidneys. The patient succumbing after multiple-stage resection according to BLOCH-MIKULICZ died of strangulation ileus. — Of the patients subjected to primary colonic resection one died of peritonitis; this was a case of cancer in the right portion of the transverse colon, where peritoneal separation of the resection site was not feasible, and where therefore actually extrusion according to BLOCH-MIKULICZ would perhaps have been preferable. — Of the 23 cases operated by us with the technique described above, viz. with peritoneal separation of the site of resection, 2 of the patients died, one of bronchopneumonia and one of pulmonary embolism; in both cases no reaction from the peritoneum was found on autopsy.

The follow-up findings, as they appeared on re-examination in the summer of 1946, are detailed in Table 6 and 7.

Of the 55 patients subjected to radical operation and discharged from the hospital, 26 were alive at the re-examination

Table 6.  
*Time of Death and Type of Resection.*

		Within $\frac{1}{2}$ Y.	Within $\frac{1}{2}$ —1 Y.	Within 1—2 Y.	Within 2—3 Y.	Within 3—4 Y.	Within 4—5 Y.
Ileocaecal resection	21 cases	2	4	3	—	—	—
One-stage resection	28 cases	2	1	4	4	—	—
Multiple- stage re- section of Bloch-Mi- kulicz	14 cases	1	3	4	—	1	—
Total		5	8	11	4	1	—

Table 7.

*Patients Living on Follow-Up Examination and Type of Resection.*

		Period of observa- tion	$\frac{1}{2}$ Y.	$\frac{1}{2}$ —1 Y.	1—2 Y.	2—3 Y.	3—4 Y.	4—5 Y.	5 Y.
Ileocaecal resection	21 cases		1	3	2	—	—	1	1
One-stage resection	28 cases		—	—	2	5	4	3	—
Multiple- stage re- section of Bloch-Mi- kulicz	14 cases		1	1	2	—	—	—	—
Total			2	4	6	5	4	4	1

carried out in the summer of 1946. 29 had died of their cancer or of other diseases. Of the 26 living, 2 had been under observation for 5 months, 4 for from  $\frac{1}{2}$  to 1 year, 6 for from 1 to 2 years, 5 for from 2 to 3 years, 4 for from 3 to 4 years, 4 for from 4 to 5 years, and 1 for more than 5 years.

The follow-up findings for the various types of resection (see Tables 6 and 7) are fairly uniform and do not yield conclusive evidence in favour of any individual procedure.

### Summary.

The writers report on their series of colonic cancer cases treated during the six-year period May 1st, 1940 to April 30th, 1946. The series comprises 107 cases. 16 patients were admitted with

peritonitis or well-defined abscess, and 29 with symptoms of acute ileus.

In the majority of cases with symptoms of ileus a relieving fistula was made. 63 patients could be subjected to radical operation.

For tumours involving the caecum, ascending colon and hepatic flexure, we advise ileocaecal resection. Of this type 21 operations were carried out, with 4 deaths, all principally due to pulmonary and cardiac complications.

In cases of tumour situated in the transverse colon and splenic flexure, multiple-stage resection according to BLOCH-MIKULICZ should be performed. 14 resections of this type for tumour in the left colon entailed only one death.

When dealing with tumour of the descending colon, sigmoid flexure, and pelvic colon, we prefer one-stage resection with separation of the resection site by suturing peritoneum on to or over it, followed by drainage, according to the technique described in detail.

23 operations of this type were followed by 2 deaths of bronchopneumonia and pulmonary embolism respectively. In spite of both purulent discharge and faecal fistula developing in some instances, peritonitis was never observed.

The procedures suggested for the different seats of cancer yielded fairly uniform results, both as regards the primary mortality and the follow-up findings.

### Zusammenfassung.

Verf. berichtet über sein in den 6 Jahren 1. 5. 1940—30. 4. 1946 behandeltes Material von Kolonkrebsen. Dieses bestand aus 107 Fällen. 16 Fälle wurden mit Peritonitis oder abgesacktem Abszess eingeliefert, 29 mit akuten Ileussymptomen.

Bei Ileussymptomen wurde in der Mehrzahl der Fälle eine entlastende Fistel angelegt. An 63 Fällen konnte die Radikalooperation vorgenommen werden.

Bei Tumoren des Zäkum, des Colon ascendens und der Flexura hepatica wird die Ileozäkalresektion empfohlen. Es wurden 21 Eingriffe dieser Art vorgenommen mit 4 Todesfällen, alle hauptsächlich durch Lungen- und Herzkomplikationen bedingt.

Bei Tumoren des Colon transversum und der Flexura lienalis ist



eine Seaneeresektion nach BLOCH-MIKULICZ vorzunehmen. Bei 14 Resektionen dieser Art wegen eines Tumors der linken Partie des Kolon kam nur ein Todesfall vor.

Bei Tumoren des Colon descendens, der Flexura sigmoidea und des Colon pelvinum wird direkte Resektion empfohlen mit Ausschliessung des Resektionsgebietes durch An- oder Übernähen von Peritoneum und Drainage nach einer beschriebenen Methode.

Auf 23 Eingriffe dieser Art folgten 2 Todesfälle an Bronchopneumonie bzw. Lungenembolie. Obwohl bei einigen Fällen sowohl Eiterung als auch Fäkalfistel auftraten, kam eine Peritonitis niemals zur Entwicklung.

Die bei verschiedenem Sitz des Krebses vorgeschlagenen Eingriffe haben sowohl in bezug auf primäre Mortalität als auch auf Spätresultate einigermaßen gleichartige Resultate gegeben.

### Résumé.

Les auteurs apportent leur matériel de cancers du colon traités pendant la période de 6 années allant du 1. V. 1940 au 30. IV. 1946. Il comprend 107 cas. Seize d'entre eux, à l'admission, avaient de la péritonite ou un abcès localisé, 29 des symptômes aigus d'iléus.

En présence de symptômes d'obstruction on a, dans la plupart des cas, établi une fistule de décharge. 63 cas purent subir l'opération radicale.

Pour les tumeurs du caecum, du colon ascendant et de l'angle hépatique c'est la résection iléo-coecale qui est recommandée. 21 interventions de ce genre furent exécutées avec 4 morts, toutes dues principalement à des complications pulmonaires et cardiaques.

Dans les tumeurs du transverse et de l'angle splénique il faut réséquer en plusieurs temps, à la façon de BLOCH-MICKULICZ. 14 de ces résections pour tumeurs du colon gauche n'ont entraîné qu'un seul décès.

En cas de tumeurs du descendant, de l'S iliaque et du colon pelvien les auteurs recommandent la résection directe, avec séparation de la région opérée, soit en suturant le péritoine à l'intestin, soit en recouvrant celui-ci de péritoine, et en y ajoutant un drainage selon la méthode qu'ils décrivent.

23 interventions pareilles ont été suivies de deux morts, l'une par bronchopneumonie, l'autre par embolie. Bien qu'on ait vu

apparaître dans quelques cas aussi bien une suppuration qu'une fistule coecale il ne s'est jamais développé de péritonite.

Les interventions proposées pour les différents cancers selon leur siège ont donné des résultats assez comparables, aussi bien en ce qui concerne la mortalité immédiate que les aboutissements éloignés.

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## The Technique in Transarticular Nailing Arthrodesis in the Hip-Joint.

By

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For arthrodesis in the hip-joint many different methods have been proposed. The various intra-, juxta- and para-articular operative procedure or combinations between them, however, are major operations with a long and trying after-treatment. These methods are seldom suited for persons over 60 years of age.

Our facilities for rendering assistance and relief to elderly persons with conditions of arthrosis in the hip-joint are very limited. This lack is particularly marked as regards arthrosis in the hip-joint due to caput necrosis after medial collum fracture.

The transarticular nailing arthrodesis seems to have provided a method which may be suited also for elderly persons. A Smith-Petersens wing-nail is introduced extra- and transarticularly along a wire-guide. In order to obtain a satisfactory fixation, the nail must penetrate 4—5 cm. into the pelvic bone. BURNS demonstrated his first case in 1935. Under the designation "extra-articular subcutaneous arthrodesis" WATSON-JONES in 1938 had employed the method in 13 cases. The observation period was short and nothing was reported about the definitive results of the operation. KARLÉN (1944) treated and followed up 9 cases. In 7 of these cases he found osseous ankylosis, and in no less than 8 "the working capacity was restored".

KARLÉN's results are so encouraging that the method well deserves consideration in these often rather hopeless cases of arthrosis in elderly persons. Although the operative procedure is simple,

complications, connected with the technique, during the operation or postoperatively are not infrequent.

In the following I shall confine myself to some complications connected with the technique in transarticular nailing arthrodesis.

### 1) *Extrusion of the nail.*

In KARLÉN's series of 9 cases this complication occurred 4 times and the stated reasons were: inadequate fixation of the nail, diastasis in the joint after driving in the nail and osteolytic processes round the nail. BURNS (1939) found the same complication twice in 12 cases.

WATSON-JONES has emphasized that the head of the nail at operation should be sunk in the cortex of the femur, and BAILEY has designed a special instrument for the same purpose. It is hoped thereby to obtain such a marked bone formation round the head of the nail that its tendency to extrusion would be obviated.

WATSON-JONES has also used a "cross-pin" through the head of the nail with attachment in the outer cortex of the femur. These cross-pins have been found to provide inadequate fixation: they may get loose and be dislocated in the soft parts.

In order to prevent extrusion of the nail, KARLÉN (1944) has tried to furnish the wings of the nail with notches. The purpose is that, after the lapse of some time, through the ingrowth of firm connective tissue between the notches on the wings an adequate fixation of the nail shall be obtained.

These various attempts to prevent the extrusion of the nail have not been found sufficiently effective, at any rate if one desires a mobilization of the patient as soon as possible after the operation.

### 2) *Subtrochanteric fractures of the femur.*

In order that the nail may penetrate sufficiently far into the supraacetabular region, it must obtain a sufficiently oblique position in the collum. The place where the nail is driven in must lie somewhat lower down on the femur than in osteosynthesis of medial fractures of collum femoris. The cortex of the femur here is very massive. If an attempt is made to drive the nail direct on the guide, cracks will be produced in the bone round that place. In connection with the operation or after postoperative strain on the leg, subtrochanteric fractures proceeding from the place



Fig. 1.

Arthrosis deformans coxae — transarticular nailing arthrodesis.



Fig. 2.

Caput-necrosis after medial fracture of the collum femoris — transarticular nailing arthrodesis.

where the nail has been driven in may be produced. BURNS among his 12 cases had two cases with this complication.

In order, if possible, to avoid this mishap, WATSON-JONES (1938) and CHAPCHAL (1941) have recommended that a stellar figure fitting the wings of the nail should be cut in the cortex round the wire guide.

### 3) *Diastasis in the joint.*

In driving-in the nail a diastasis between the articular surfaces often occurs. This diastasis usually disappears, when weight is put on the leg postoperatively. In this connection, however, the nail is liable to be extruded, if its head has not been effectively fixed.

### 4) *Failure to drive the nail home.*

In cases of marked sclerosis of the articular surfaces it may be difficult to drive in the nail sufficiently far—at least 4 cm. KARLÉN has reported a case where, at two operations, the nail could not be driven into pelvic bone more than about 2 cm. Not until a third operation, after drilling the articular surfaces with a 3 mm. drill, could the nail be driven in sufficiently far.

The technique, which at Sabbatsberg's Hospital is adopted in osteosynthesis of inter- and pertrochanteric fractures of the femur, and which I previously have described (ARONSSON, 1945, 1946) seems to be suitable also in transarticular nailing arthrodesis.

This osteosynthesis is a combination of Smith-Petersen's three-angled nail with a transverse screw through a rotatable head of the nail. In order to facilitate the introduction of this screw and to obtain a diametral support for the screw in the femur, a nail with a rotatable head has been employed. The set of instruments is made by AXEL ERICSSON, Gothenburg. The X-ray pictures of two operated cases are shown in figs. 1 and 2.

With this operative technique, it seems that the above described complications during and after operation can be avoided.

*Ad 1.* The tendency of the nail to extrusion is obviated by a transverse screw through the rotatable head of the nail. The appearance and design of the nail are shown by figs. 3 and 4.

In order to obtain a fully satisfactory fixation, the screw must be of sufficient thickness, 6 mm., it must have a support in both the outer and the inner cortex of the femur and as diametral a

position in the femur as possible. The rotatable nail-head with its transverse channel (fig. 4) can be adjusted in the direction best suited for the introduction of the screw through the femur. The

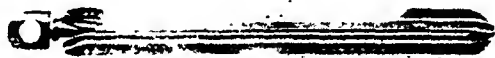


Fig. 3.

Nail with transverse channel through the head.



Fig. 4.

Cross section through nail with transverse channel in the rotatable head.

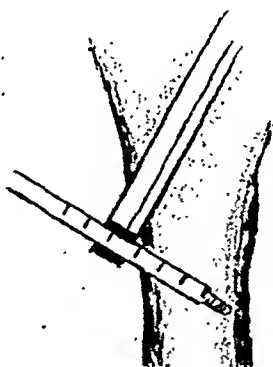


Fig. 5.

outer cortex of the femur is then drilled with a drill of the same diameter as the screw. The inner cortex of the femur, on the other hand, is drilled with a drill 4 mm. in thickness at the tip, provided with a graduated scale in cm., so that the most suitable screw-length can be directly read (fig. 5).



Even if in the driving-in of the nail a diastasis in the joint should occur — which, as above indicated, will disappear, when weight is put on the leg — the nail cannot slip out: on the contrary, the point of the nail will penetrate still deeper into the pelvic bone.

*Ad 2.* With the aid of v. Bähr's three-cut chisel (v. BAHR, 1946) the nail can be easily and neatly driven in without the risk of causing a subtrochanteric fracture of the femur. The design of the three-cut chisel is shown by fig. 6.



Fig. 6.

- A. Preparatory drill for said chisel.
- B. v. BAHR's three-cut chisel.

With the preparatory drill (fig. 6 B), 6.3 mm. in diameter, a groove with a diameter exactly corresponding to the core of the nail is drilled round the wire guide. With the three-cut chisel (fig. 6 A) a stellar figure is then gradually punched out in the cortex. The figure exactly corresponds to the wings of the nail. The three-angled nail can then be inserted without damaging the cortex.

*Ad 3 and 4.* In order to lessen the tendency to diastasis in the joint, when the nail is being driven in, and to facilitate the driving-in of the nail through markedly sclerosed articular surfaces, preparatory drilling of the caput and articular surfaces is to be recommended. When the stellar figure round the wire guide has been cut with v. Bähr's chisel, it is easy, through the stellar figure cut in the cortex, with a 3 mm. wire-drill, to perforate the caput and articular surfaces in some ten directions. Moreover, the osteogenesis is stimulated in the same way as in drilling according to the method of Beck, and the prospects of healing with osseous ankylosis — the object in every arthrodesis — are improved.

Even when a wire guide is used, the nail may deviate from the

planned direction, perhaps chiefly owing to the resistance in the sclerotic articular surfaces. In this situation as well as in cases of fracture of the nail, an instrument for the extraction of the nail is required. Such an instrument for the Smith-Petersen's nails has been designed by HIRSCH (1947). Nails used in the here described technique can easily be extracted with the simple instrument shown in fig. 7, the use of which scarcely needs any detailed explanation. The fracture of the nail, of course, jeopardizes the result

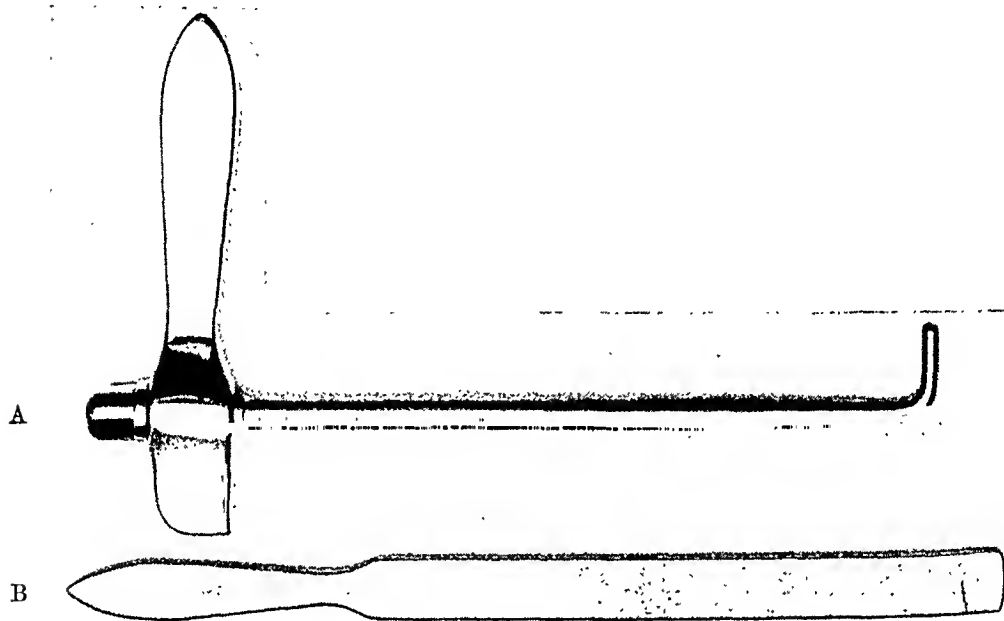


Fig. 7.

- A. Instrument for nail extraction.  
B. Hammering bar.

of the operation and is a very unwelcome complication, though not connected with the operative technique. By reserving the transarticular nailing arthrodesis for severely destroyed joints with considerably restricted mobility, the risk of this complication will be reduced.

### Summary.

For arthrodesis in the hip-joint of elderly persons with arthrosis conditions, the intra-, juxta- and para-articular operative methods are seldom adapted. Transarticular nailing arthrodesis, on the other hand, in certain cases is a suitable method.

Although the technique in transarticular nailing arthrodesis is simple, certain complications during or after the operation are not infrequent. Such are: Extrusion of the nail, subtrochanteric fractures of the femur, diastasis in the joint, failure to drive the nail home.

With the technique employed by the author, it seems that these complications can be avoided.

### Zusammenfassung.

Für die Arthrodes im Hüftgelenke bei älteren Personen im Zustande der Arthrose eignen sich selten die intra-, juxta- und paraartikulären Operationsmethoden. Dagegen ist die transartikuläre Nagel-Arthrodes in gewissen Fällen als geeignete Methode anzuwenden.

Obgleich die Technik bei transartikulärer Nagel-Arthrodes einfach ist, können gewisse Komplikationen während oder nach der Operation eintreten, die mit der Technik zusammenhängen, wie zum Beispiel: Ausgleiten des Nagels, subtrochantäre Schenkel-frakturen, Diastase im Gelenke, Schwierigkeiten den Nagel tief genug einzutreiben.

Mit der vom Verfasser angewandten Technik scheinen diese Komplikationen vermieden werden zu können.

### Résumé.

Quant à arthrodes dans l'articulation de la hanche des personnes âgées en état d'arthrose les méthodes d'opération intra-, juxta- ou para-articulaire ne sont que rarement indiquées. Cependant l'arthrodes de clou est une méthode applicable dans certains cas.

Bien que la technique de l'arthrodes articulaire de clou soit simple de certaines complications pendant l'opération ou après celle-ci en rapport à la technique ne sont pas rares: Glissement du clou, des fractures de fémur subtrochantériennes, diastase dans l'articulation, des difficultés d'enfoncer le clou assez au fond.

Avec la technique citée par l'auteur il semble qu'on puisse éviter ces complications.

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## Anuria Observed in Connection with Penicillin Therapy.

By

BENGT NYLÉN.

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### Literature on toxic reactions in penicillin therapy.

In penicillin therapy, secondary effects of that substance have been observed in a relatively small number of cases. These reactions are usually attributed to impurities in the penicillin (1—8, etc.), and several authors (4, 5 and 9) have shown that the toxicity of the penicillin is directly proportional to the degree in which it contains impurities. Lethal dose experiments have made it clear (6 and 7) that the permissible dosage of penicillin rises relatively to its degree of purity. Moreover, the cation used in the injection may be a factor of some importance; indeed, the toxic symptoms may be wholly attributable to it (10).

According to FLOREY and JENNINGS (9), the reactions caused by the impurities are: Trombophlebitis at the place of injection, general urticaria, slight rise of temperature and pain after intramuscular and subcutaneous injection. — FLOREY and FLOREY (2) as well as LYONS (3) in connection with penicillin therapy have observed a slight increase in the non-protein nitrogen: according to the first-mentioned authors, the rise was proportional to the amount of penicillin administered. On the termination of the therapy, it was found that the non-protein nitrogen had reverted to its original value. The rise as a rule did not exceed 5—10 mg%. The authors observed no albuminuria, occasionally some cylinders, but no other symptoms of azotaemia. According

to TURNER *et al.* (11), this azotaemia is due to the fact that penicillin reduces the effect of urease. But seeing that the penicillin concentrations used in clinical practice are comparatively low, the correctness of this explanation may be questioned (12). According to FLOREY and JENNINGS (9), the transient azotaemia is due to the rapid breaking-down of the penicillin in the body.

According to several experiments with concordant results (13—18), penicillin is excreted largely by tubule secretion. By administering diodrast or para-amino-hippuric acid concurrently with penicillin, these authors have shown that penicillin is then retained longer and at a higher level in the blood than normally, whilst the excretion of penicillin is prolonged and diminished. Attempts have also been made to utilize this fact for clinical purposes. The explanation of this change in the excretion, according to the authors, is that in the struggle between the different substances for discharge through the tubuli, the excretion of penicillin is suppressed. It has been shown by RANTZ and co-workers (19) that, in correspondance with other substances excreted through the tubuli, some variation in the urine volume per minute does not affect the actual amount of penicillin excreted. By clearance determinations, the same authors have ascertained that, on the injection of penicillin, the blood circulation through the kidneys increases; this is stated by them to be due to pyrogenic substances contained in the impurities with which the penicillin is contaminated.

When the renal function is impaired, as has been found by several investigators, the excretion of penicillin is reduced, and the penicillin level rises higher than normally in the blood (18, 20—23). An adequate concentration of penicillin in the blood can thus be maintained by a smaller dosage.

COOKE and GOLDRING (23), in a case of acute meningitis where sulphamerazine and penicillin were administered for a considerable length of time, found that the amount of urine successively diminished until complete anuria resulted, concurrently with an increase of the non-protein nitrogen and a higher penicillin level in the blood. At the postmortem no pathologico-anatomical explanation of the anuria could be found. JENSEN *et al.* (18) report a case of sepsis with complete anuria and with a considerable rise of the penicillin level.

CHAIN and his coworkers (1) on a few occasions observed slight damage to the tubulus cells in experimental animals in connec-



tion with penicillin injections. JENSEN *et al.* (18) observed in a dog a protracted excretion of penicillin, which is stated to have been due to a subchronic pyelonephritic focus in the one kidney. — PERLSTEIN and his associates (24), in experiments on rabbits with injection of large doses of penicillin, produced a complete anuria during the first twenty-four hours. The anuria gradually receded in the course of the 2nd and 3rd day; on the 4th day of this penicillin treatment the amounts of urine were again normal. At the same time these investigators observed a positive albumin reaction, which diminished in the course of the 2nd and 3rd day, in order to become again negative on the 4th. According to the authors, this positive albumin reaction was due to the impurities in the penicillin: if acetone or ethyl alcohol was added before the albumin test was made, no precipitation was observed. The authors consider that with a high dosage of penicillin it would be possible also in clinical treatment to produce a positive albumin reaction, due to the said impurities. Possibly, in this experiment on rabbits, renal damage had been caused by the penicillin injections.

In a lengthy series of experiments on rats (8), no toxic effects from the injection of penicillin were observed, not did the investigators find that penicillin caused any contraction of the pregnant uterus in animals, or that it had any effect on the blood vessels.

### Own observations.

At the surgical clinic of the Academic Hospital at Upsala in 1945 a case was observed where it may be presumed that penicillin had a toxic effect on the kidneys.

The patient was a man aged 78, formerly a farmer, with no hereditary traits of special interest. For many years he had suffered from rheumatism, for which he was treated in 1944 at the medical clinic of the hospital. In regard to renal function nothing noteworthy was observed. In 1936 he was operated at the surgical department for hernia lineae albae incarcerata. He had never had any trouble in urination, and the amounts of urine had never been particularly small.

The patient was admitted to the surgical clinic on the 9th May 1945, with a strangulated, left-sided inguinal hernia of several hours' standing. The general condition was affected. He was operated on the same day. At the operation, which was very troublesome, an intestinal perforation occurred. The operation was therefore performed merely palliatively, with suturing of the ruptures and repositioning of the



intestine. Sulphathiazole ( $1\text{ g} \times 3$ ) was administered immediately after the operation. Postoperatively the patient had an abdominal phlegmon. Ten days after the operation he had an intense sulphaexanthema with sulpha crystals in the urine. The sulpha preparation was therefore dropped and penicillin was administered for 5 days, 100,000 Oxford units per day intramuscularly, at first with a favourable effect. About three weeks after the operation the abdominal phlegmon had sunk down on the right thigh, where melting occurred. After incision on the 7th June a transient improvement, whereupon the inflammation again flared up.

The table shows that the amounts of urine, which had previously been quite normal, from the 13th June had gradually diminished to complete anuria on the 19th of that month. As is also seen, the non-protein nitrogen, which on the 14th May was 46 mg %, rose to 150 mg % on the same day that the anuria appeared, but then rapidly receded. As a sign of the flaring-up of the phlegmon on the right thigh, the number of white cells increased to 15,000—20,000, afterwards rapidly diminishing. As the patient had also shown signs of a left-sided thrombosis, 0.25 g Dicoumarin was administered on the 14th June. As the table shows, sulphathiazole ( $1\text{ g} \times 3$ ) was given on the 12th June, but this medication was dropped on the following day, in view of the patient's previous exanthema. Penicillin, 100,000 Oxford units per day intramuscularly, was administered on the 13th June, but the treatment was discontinued on the 18th, the day before that on which the anuria occurred. The patient's condition gradually improved, the urine showed nothing noteworthy; the amounts of urine were at first overnormal, but afterwards returned to normal. The patient was discharged on the 3rd July.

In November 1945 the patient was readmitted to the medical clinic of the hospital because of chronic polyarthritis. The blood values showed nothing pathological, the Heller test now revealed albuminuria. Blood pressure 155/65. No other signs of renal damage. — In January 1946 the patient was readmitted to the surgical clinic, then with a complete anuria, which lasted for 5 days. He had symptoms of an acute pyelonephritis. A skiagram of the abdomen showed a normal renal shadow on the right side, whereas no distinct renal shadow could be distinguished on the left. In cystoscopy the catheter could be easily introduced on the right side, but on the opposite side not more than 7—8 cm. No urine in either of the catheters. Non-protein nitrogen 160 mg%. The patient had not been given any medicine. After decapsulation on the right side, the secretion started again, and the patient since then has been quite well.

At a follow-up examination in November 1946 the findings were: General condition very good. SR 87 mm, non-protein nitrogen 43 mg%, other blood values normal. Heller test negative, the sediment showed a few white and red cells. The X-ray now showed a distinct renal shadow on the left. Intravenous urography revealed after 5 minutes a thin excretion on both sides. Inulin clearance 47 cc per minute, diodrast clearance 175 cc per minute and serum circulation 319 cc per minute.

(The figures are rather low, being about 35 % of the normal values, but, in view of the patient's age and the anamnesis, not remarkably low.)

### Discussion of the case.

The cold chill with a slight rise of temperature which occurred on the 13th June (see the table), when the sulpha preparation was replaced by penicillin, may have been due either to the said preparation or to the penicillin. According to FLOREY and JENNINGS (9) and FLOREY (25), penicillin therapy often results at first in a slight rise of temperature, which is stated by FLOREY to be due to increased resorption of bacterial decomposition products.

The complete anuria on the 19th June 1945 in this case cannot be accounted for by the primary disease, in view of the rapid increase in the amounts of urine after the 20th June. Presumably, it was closely connected with the therapy introduced on the days immediately preceding the anuria. The patient was given 3 g sulphathiazol on the 12th June but that is too small a dose to account for the anuria 8 days later. No sulpha crystals were found in the urine and the leucocytes showed no diminution, but, on the contrary, a considerable increase.

The explanation of the anuria in this case seems to be that the *penicillin* had a transiently unfavourable effect on the kidneys, as is indicated particularly by the fact that the excretion of urine rapidly started again on the second day after the penicillin had been stopped. In the literature I have not found any quite analogous case, though a somewhat similar one has been reported by COOKE and GOLDRING (23), whilst PERLSTEIN and coworkers (24) in experiments on rabbits have obtained a corresponding effect on the secretion of urine. The purity of the penicillin used in the here reported case was about 300—500 Oxford units per mg.

It is conceivable that in the case of a renal irritation such as had evidently existed here the reserve capacity of the kidneys is so small that the penicillin, most probably owing to the impurities contained in it, might have exercised an injurious effect, with resulting anuria.

### Experimental investigation.

In order to investigate whether penicillin, in case of damaged kidneys, had any effect on the diuresis, I made the following experiment at the Histological Institute in Upsala. From 17 male rats, about 4 months old, the left kidney was extirpated, and about a fortnight later the right kidney was operated, with removal of the upper and lower poles [for the operative procedure, see E. MOBERG (26)]. The left kidney and the operated part of the right kidney were weighed. From a control group of 12 rats of the same strain as the preceding ones, the left kidney was extirpated, and after a fortnight the right kidney was operated with removal of both poles, whereupon the rats were immediately killed and the remainder of the kidneys was removed and weighed, as well as the operated parts. After the termination of the experiment, the right kidneys in the experimental group were weighed. On the basis of the weights before and after the operations, the approximate renal substance of the experimental animals could be estimated: after the second operation about 45 per cent of the original substance was left, and by the time when the experimental animals were killed, it had increased to about 75 per cent. (This doubtless implies a too good renal function, scarcely corresponding to the 35 per cent of normal clearance in the patient.)

After about one month the rats were placed in cages, where during the whole experiment the urine was daily collected and measured. The quantity of water consumed by the rats was likewise measured daily and the animals were weighed every other day. The collected urine was subjected to Heller's albumin test daily or every other day. After about 10 days or more, the animals having been divided into two approximately equal groups, 5 experimental animals in the one group were injected intramuscularly with 15,000 Oxford units of penicillin per 24 hours, distributed in 6 injections, whilst 4 served as controls with the injection of an equivalent amount of 0.9 % saline solution; and 4 experimental animals in the other group were injected intramuscularly with 30,000 Oxford units of penicillin per 24 hours, likewise with 4 controls. After the lapse of 4 days the injections were discontinued and the animals were kept alive for 6 days, whereupon they were killed. The kidneys were weighed and prepared for histological examination. The urea-nitrogen determinations

were made before, during and after the test, according to the method of OHLSON (27).

*Results:* In these tests the experimental animals showed no difference from the controls in regard to the amounts of urine after the injection of penicillin for 4 days. Nor did the rats show any difference in weight during the course of the experiment. The tests for albumin in majority of cases were positive before the penicillin injections; as compared with the tests previous to the injections, no difference was shown by the tests during or after the injections. Nor was there any observable difference between experimental animals and controls with respect to the albumin reaction. On histological examination it was found that both in the experimental and control groups the kidneys were considerably damaged, but no marked difference between them was observed. The urea-nitrogen determinations during the course of the experiment showed no difference between the groups.

According to this experiment, it seems that penicillin injections in rats whose kidneys have been damaged have no inhibitive effect on the diuresis. — The purity of the penicillin used in the experiments was about 1,300 Oxford units per mg, thus considerably purer than the penicillin used in the clinical case, whence the negative result in the experimental test can be explained on this ground.

### Summary.

The reports in the literature on toxic reactions in penicillin therapy, with special regard to the kidneys, are reviewed. Thus, it is noted that FLOREY and FLOREY (2) as well as LYONS (3) have observed minor transient rises of the non-protein nitrogen in penicillin therapy, but no albuminuria nor any other signs of renal damage. It has been found that the penicillin is excreted for the most part through the tubuli (RAMMELKAMP and others). When the renal function is impaired, penicillin is excreted more slowly and to a lesser extent than in normal cases and the penicillin level in the blood is higher than normally (RAMMELKAMP, KEEFER and others).

COOKE and GOLDRING (23), in a case of acute meningitis which for a considerable length of time had been treated with sulphamerazine and penicillin, observed a gradual decrease of the

amounts of urine till complete anuria; at the postmortem no pathologico-anatomical explanation of the anuria could be found.

PERLSTEIN and coworkers (24) experimentally produced complete anuria in rabbits by the injection of large doses of penicillin; the anuria receded on the second day after the commencement of the penicillin injections, and the amounts of urine were again normal on the 4th day of the test. The reactions observed in penicillin therapy are generally attributed to impurities in the penicillin (1—8, etc.). The author reports a case of his own where it is probable that the penicillin had had a toxic effect on the kidneys, with consequent anuria. In an experimental investigation of his own, the author found that the penicillin used in the animal experiments had no diuresis-inhibiting effect on rats with damaged kidneys; it should be noted, however, that this penicillin contained less impurities than that which had been administered to the patient in question. In view of the fact that the penicillin obtainable on the market is not synthetically made, but a biological product, its content of impurities may vary. Possibly occurring unfavourable secondary effects, especially in the form of an impaired renal function, should therefore be carefully watched.

### Zusammenfassung.

Es wird ein Überblick über die in der Literatur vorhandenen Berichte von toxischen Reaktionen in der Penicillintherapie, mit besonderer Berücksichtigung der Nieren, gegeben. Dabei wird bemerkt, dass FLOREY und FLOREY (2) sowie LYONS (3) kleine vorübergehende Zunahmen des Nichtprotein-Stickstoffs bei der Penicillintherapie, aber keine Albuminurie und auch keine sonstigen Zeichen von Nierenschäden beobachtet haben. Es wurde gefunden, dass das Penicillin grösstenteils durch die Kanälchen ausgeschieden wird (RAMMELKAMP und andere). Bei verschlechterter Nierenfunktion wird Penicillin langsamer und in geringerer Menge abgeschieden als in normalen Fällen, und der Penicillin-gehalt des Blutes ist höher als normal (RAMMELKAMP, KEEFER und andere).

COOKE und GOLDRING (23) beobachteten in einem Fall akuter Meningitis die lange Zeit hindurch mit Sulfamerazin und Penicillin behandelt war, eine stufenweise Abnahme der Harnmenge bis zu völliger Anurie; bei der Obduktion wurden keine pathologisch-anatomischen Erklärungen der Anurie gefunden.

PERLSTEIN und seine Mitarbeiter (24) erzeugten experimentell völlige Anurie bei Kaninchen durch Injektion grosser Penicillinmengen; die Anurie nahm am zweiten Tag nach Beginn der Injektionen ab, und am vierten Versuchstag waren die Harnmengen wieder normal. Die in der Penicillintherapie beobachteten Reaktionen werden allgemein auf Verunreinigungen des Penicillins zurückgeführt (1 bis 8 usw.). Der Verfasser berichtet einen eigenen Fall, wo Penicillin wahrscheinlich toxische Wirkung auf die Nieren hatte, worauf Anurie eintrat. Bei eigenen experimentellen Untersuchungen fand der Verfasser, dass bei Tierversuchen das Penicillin keine diuresisverhindernde Wirkung auf Ratten mit Nierenschäden ausübte; es ist aber zu bemerken, dass dieses Penicillin weniger Unreinheiten enthielt als das bei dem betreffenden Patienten benutzte. Da das im Markt erhältliche Penicillin kein synthetisches, sondern ein biologisches Erzeugnis ist, schwankt sein Gehalt an Verunreinigungen. Deshalb müssen etwaige ungünstige Nebenwirkungen, zumal in Form verschlechterter Nierenfunktion, sorgfältig beobachtet werden.

### Résumé.

Les rapports présentés dans la littérature médicale concernant les réactions toxiques dans le traitement au penicillin, particulièrement en ce qui concerne les reins, ont été étudiés. Il ressort de cette étude que FLOREY et FLOREY (2) ainsi que LYONS (3) ont observé de faibles augmentations momentanées du nitrogène non protéineux dans le traitement au penicillin. Par contre, ils n'ont noté ni albumine ni autres signes d'affectations rénales. On a trouvé que la plupart du temps le penicillin est rejeté par les voies tubulaires (RAMMELKAMP et autres). Lorsque la fonction rénale est réduite, le penicillin est excreté plus lentement et dans de moins fortes proportions que dans les cas normaux, et le degré de penicillin dans le sang est plus élevé qu'à l'ordinaire. (RAMMELKAMP, KEEFER et autres).

COOKE et GOLDRING (23), dans un cas de méningite aiguë, qui avait été traité assez longtemps avec du sulphamerazine et du penicillin, ont observé une diminution graduelle des quantités d'urine jusqu'à l'anurie complète; à l'autopsie aucune explication pathologique-anatomique ne put être formulée.

PERLSTEIN et ses collaborateurs (24) ont provoqué, par voie



expérimentale, l'anurie complète sur des lapins en leur injectant de fortes doses de penicillin; l'anurie cessa le deuxième jour après le commencement des injections et les quantités d'urine étaient normales déjà le 4<sup>ème</sup> jour de l'essai. Les réactions observées dans le traitement au penicillin sont en général attribuées aux impuretés contenues dans le penicillin (1—8, etc.). L'auteur cite un cas, traité par lui, où il semble que le penicillin eut un effet toxique sur les reins, suivi d'anurie. Au cours d'une étude que l'auteur entreprit, il trouva que le penicillin utilisé pour expérimenter sur les animaux ne possédait pas de qualités réduisant le diurèse sur des rats dont les rognions étaient malades; il est à observer, toutefois, que ce penicillin contenait moins d'impuretés que le penicillin administré au malade en question. Du fait que le penicillin que l'on trouve sur le marché n'est pas fabriqué synthétiquement, mais constitue un produit biologique, les impuretés qu'il contient peuvent varier. Les effets nuisibles, d'ordre secondaire que peut produire le penicillin, particulièrement sous la forme d'une réduction de la fonction rénale, devraient par conséquent être soigneusement observés.

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## Intratracheal Goitre.

By

LARS THORÉN.

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Several forms of aberrant goitre are serious owing to the stenotic symptoms from the upper air passages produced by the same. Such is the case in respect to the fairly frequent lingual form which causes respiratory trouble when it has reached a relatively considerable size. Far more uncommon is both the intratracheal and intralaryngeal goitre which for easily conceived reasons occasions considerable obstructive dyspnea already at a stage of slight proportions. Only one case of this form of goitre has hitherto been published in Sweden (HULTÉN 1937). In all the literature issued after 1875, when the first case was described by von ZIEMSEN the author has only come across 79 cases of which about 20 are only mentioned in congress or other reports.

Usually the collective term intratracheal goitre is used to indicate normal or diseased thyroid tissue situated within the trachea or larynx (as a rule in the caudal part of the larynx). This term intratracheal goitre is employed here although the expression in some respects is inappropriate.

The following history reveals a rather characteristic course for intratracheal goitre.

Report C: 1539/1946, M. E. A. A woman 30 years old.

*Diagnosis:* Struma colloidis nodosa partim intratrachealis + Graviditas mens VIII + Suffocatio. — The patient has suffered from goitre since the age of 13—14. This has gradually grown the last 5 years and the patient has been troubled with increasing shortness of breath. She had a child in 1942. Increased respiratory trouble during pregnancy, especially difficult at partus. The trouble diminished after the delivery but was accentuated in connection with menstruation. Became preg-

nant again in 1946 whereupon, at the beginning of the same, surgical treatment was advised and declined. Gradually enhanced respiratory difficulties during the pregnancy, and an acute change for the worse set in prior to being admitted to the Sundsvall Hospital in connection with a cough and catarrhal symptoms.

*State on arrival 28. 4. 46.* The patient breathed with inspiratory and expiratory difficulty. At the oto-laryngologic Department, the larynx had been sprayed with Biogan (a vascular constrictive expedient from A. B. Recip, Stockholm) upon which the respiratory troubles decreased rather speedily on arrival. No difficulty in swallowing. *Thyreoidea:* Considerable diffuse enlargement with moderation over the upper part of the sternum. Even consistency, soft, elastic. The goitre is displaced when swallowing. No symptoms of thyreotoxicosis.

*Laryngoscopy:* Mucous membrane in the larynx red and swollen. Beneath the vocal cords is a rounded even indentation covered with mucous membrane, situated posteriorly to the left. This for the most part constricts the lumen which remains as a 3—4 mm wide chink. After treatment with the Biogan spray the inward curvature decreases somewhat in size.

*Roentgen investigation (EVERS)* (see Fig. 1): Rather large goitre with slight intrathoracic expansion. The goitre grows round the trachea with considerable increase of the shadow of the soft part between oesophagus and the trachea. In the upper part of the trachea is an indentation from behind of a soft-part-shadow the size of half a doves egg situated in the tracheal lumen which, here, is only a couple of mm wide. The trachea is slightly pushed to the right, level with the jugulum and, as a whole, slightly constricted from the front backwards.

During one hour after the arrival at the Surgical Department the condition of the patient became increasingly better with decreasing dyspnoea. After a further four hours the patient suddenly became worse, with difficulty in breathing. She rose from her bed, walked a few steps and fell to the floor. Intubation was performed a minute later. The patient breathed a time or two through the tube but a white frothy liquid soon gushed forth. Edematous foam was aspirated and artificial respiration was administered. The action of the heart ceased in spite of intense stimulation. Intracardial adrenalin injection was without effect.

*Autopsy* (the author): Very fat. no edema. — *The neck:* Thyreoidea considerably enlarged (350 g). Each lobe is as large as a good sized goose's egg with a broad and voluminous isthmus. On a level with the upper part of the trachea one finds that the left part of the thyreoidea has grown backwards and developed an adenomatous growth the size of a large walnut, which lies to the left of the middle line and behind the larynx. From this adenoma one can follow a filament of goitre tissue the width of a pencil which invades the trachea between the lamina cartilaginosa cricoidis and the first tracheal cartilage. On the inside of the cartilaginous skeleton this filament is connected with a good sized hazel nut of goitre tissue (see Figs. 2 and 3). The intra-tracheal growth forms a round, broad-based tumour, which is covered

with normal, displaceable mucous membrane and which constricts the lumen so that only  $\frac{1}{4}$  remains. The induration proceeds from the left posterior part of the lumen. The mucous membrane in the larynx and trachea is swollen and red. — *Lungs*: Edema and acute stasis. No subpleural hemorrhage. — *Heart*: Weight about 300 g. — *Liver*: Macr. signs of acute stasis. — *Uterus*: Graviditas mens VIII.

*Microscopic investigation*: The extra- and intratracheal parts of the goitre are of the same histologic type, namely, that of the struma colloidosa devoid of apparent signs of dysfunction. (See Fig. 5.) The part lying in the trachea reaches close up to the tracheal cartilage's inner perichondrium but there is no evidence of pathologic fixation or ingrowth of the goitre in the perichondrium. The mucous membrane of the larynx is well delimited from the intratracheal goitre and ingrowth of the tracheal mucous glands cannot be proved. (See Fig. 4.) The mucous membrane shows signs of moderate, acute inflammation with hyperemia and infiltration of polynuclear leucocytes, also lymphocytes. The cricotracheal membrane is penetrated by continuous filaments of goitre tissue (see Figs. 2 and 5) within the posterior left part. In sections of parts of the membrane some mm at the side of the inter-growth, one finds colloid follicles interspersed, in the tracheal membrane (see Fig. 6) which, in a series of sections, would assumably have revealed themselves to be parts of marrow filaments of goitre tissue.

*Summary*: A woman aged 30 with a prominent goitre which she has had since she was 13—14 years of age, had respiratory troubles the last 5 years. They increased at times premenstrually and in connection with two pregnancies. During the latter of these there occurred a considerable deterioration. In the clinical investigation with laryngoscopy and roentgen it was assumed that the cause of the pronounced stenosis in the upper air passages was due very probably to an intratracheal goitre. Preparations were made for the operation but the patient died from suffocation although intubation and other aids were performed. This suffocation may possibly have been due, to some great extent, to a reactive swelling and hyperemia after treatment with vascular constriction expedients in connection with laryngoscopy. On performing an autopsy and through microscopic investigation one found direct connections via the cricotracheal membrane between the intratracheal goitre and a retrotracheally located part of the outer goitre. The increase in size of the intratracheal portion in connection with the pregnancy and an adjacent acute laryngitis have probably been decisive in the unfortunate issue.

*Occurrence*: The intratracheal goitre is a rare form of ectopic thyroid tissue. Of the, in themselves, unusual intratracheal

tumours, it constitutes a relatively large number (THEISEN: 7.4 %, KRIEG: 7 %, MAIER: 6.6 %). Similarly to the common outer goitre this form occurs most frequently among women, in a collocation of cases described in available literature to 72 % which undoubtedly coincides with earlier reports in the literature. The intratracheal goitre generally reveals symptoms between the ages of 15 and 40 years, but in the new-born period and earliest infancy this type of goitre with considerable stenotic symptoms, and even with suffocation has also been met with (MEYER and CAPPON 1910, WEGELIN 1926). Older persons up to the age of 67 (KAUFMANN 1906, MEIER 1914, SZENDE 1939) have been known not to be exempt from the disease.

*Pathologic anatomy:* In the majority of cases one meets with a broadbased, rounded or ovoid tumour of the size between a hazelnut and a cherry. The surface is usually smooth and it is covered with a — on the whole — normal mucous membrane whose epithelium sometimes tends to transform into squamous epithelium. A nodular or lobed surface is unusual (v. BRUN, ENDERLEN, SCHILLER, BRENTANO). In the preponderant number of cases (about 70 %) the intratracheal goitre curves into the lumen from the posterior lateral part of the subglottic section of the larynx or the upper part of the trachea with preponderance on the left side (HULTÉN 1937: proportionately left—right sided = 4:1). The position can vary considerably, however, and it has been described as lying on a level with, or just above the vocal cords (MEYER and CAPPON, GERMAN, BEESON, ALPÄR); it has also been met with in the vicinity of the tracheal bifurcation (RADESTOCK, v. HANSEMANN).

In approximately two thirds of the cases an extratracheal goitre could be observed simultaneously. Histologically, the goitre was colloidal intratracheally as a rule, but in some cases with stenotic symptoms, only normal thyroid tissue was found in the intratracheal tumour (v. ZIEMSEN, v. HANSEMANN, FEER, HOFFMANN, SEGURA). Struma Basedowoides intratrachealis has been observed once (BUNDSCHUH 1925). An independent cancerous degeneration of the intratracheal goitre with normal outer thyroid can occur (BIRCHER 1908, PRIESEL 1921). There are 2 cases more in the literature, but from the description given, in both of these an ingrowth of an incipient thyroidal carcinoma outside the trachea cannot be excluded with certainty (v. BRUN 1898, MEYER 1896).

*Genesis:* Attempts have been made to explain the origin of the intratracheal goitre in many ways. The hitherto propounded theories can on the whole be collocated in two groups:

I. The genesis of the intratracheal goitre is elucidated as a congenital anomaly which is presumed to originate in the early embryonal stages through complete or incomplete detachment of parts of the thyroid bud (v. BRUN, FALK, HULTÉN) — (*malformation theories*).

II. The intratracheal goitre is considered to come into existence postfetally through ingrowth of goitre tissue in the trachea in the event of hyperplasia of the thyroid (PALTAUF, WEGELIN). This ingrowth could also take place during the later part of the fetal life (WEGELIN) — (*ingrowth theory*).

I. In respect to the embryonal development of glandula thyreoidea there are abundant opportunities for parts of the thyroid bud to separate and develop into accessorial parts of the thyroid gland. FERGUSSON (1904) reported that of 300 autopsies such accessorial isles of thyroid tissue were found in not less than 23 cases, of which one case in the trachea. Among dogs and also among human beings (DOSCH 1941) thyroïdal tissue has been revealed even in the aortic wall and cardiac musculature.

VOX BRUN (1878) assumed that the intratracheal goitre had its origin in such detached thyroid tissue. He meant that the intratracheal goitre should be, so to say, an independent accessorial thyroid gland having no connection with the main thyroid gland, and this theory has been accepted by a number of authors. This detached part of the thyroid gland could extrauterinally grow and undergo pathologic changes which appear in connection with changes of the outer thyroid gland but also independently.

FALK (1936—1937) is of the opinion that the intratracheal goitre has its source in earlier embryonal stages and that it is due to ventral curvature of the oral cavity (BÖKER), at which parts of the thyroid embryo, through the effect of mechanic pressure, become pressed in in that part of the tissue in which the larynx and trachea are later developed. This pressed-in part of the thyroid gland remains and is partially disconnected during the formation of the cricoid and tracheal cartilages, but retains its connection with the main thyreoid gland by means of a filament. FALK supports his theory on an investigation of 21 new-born babies and infants with series sections of the larynx and trachea. He found thyreoid glandular tissue in two cases and thymus

tissue in one case intratracheally with outward connection between the cricoid and first tracheal cartilage. There seems to have been no external goitre. In three other cases FALK found a tongue of thyroid tissue which turned in towards and became intimately connected with the cricotracheal membrane backwards laterally without penetrating the same and which thus displayed an incomplete stage of detachment.

HULTÉN (1937) has published an interesting theory for the origin of intratracheal goitre. He discussed the details of a possible developmental mechanism and used HAMMAR's (1920) investigations on the development of the thyroid as his point of departure. Through examining series of human embryos (3—70 mm long) HAMMAR was able to follow the thyroid development from the median unpaired primordium which proceeds from the mesobranchial area and from a paired lateral primordium which emerges from the so-called post-(ultimo-)branchial bodies that are considered to have their origin in the fifth gill pocket. He found that the fusion between the median and the lateral thyroid primordium is different on the right and left side. The right postbranchial body lies more caudally than the left and is therefore enclosed more completely by the lateral lobe of the median primordium. On the left side the cornu of the lateral lobe only reaches the postbranchial body with its tip, and thus the enclosure is not so complete. During the earlier fetal stages it is possible to distinguish between the median and the lateral primordium microscopically, but the structure of the postbranchial bodies is successively changed so that it finally coincides with the thyroid tissue which has its origin in the median primordium. HULTÉN points out that, should the junction between the median and the lateral primordium fail to occur on either side, the lateral primordium might develop independently and give rise to an accessory thyroid gland. According to HAMMAR's investigations it would seem that the left side is favourable towards a more frequent, either absent or incomplete junction. Such an accessory thyroid gland, in such a case, might remain in the tracheal primordium and there develop further. HULTÉN found support for this theory in collocating from the literature cases where exact information had been given as to the localisation of the intratracheal goitre, when, as above mentioned, a marked preponderance for the left side could be verified (the proportion left—right side = approx. 4:1). HULTÉN's theory is assumably applicable also to cases



where a connection has been revealed between the intra- and extratracheal thyroid tissues. A junction between the median and lateral thyroid primordium, commenced and arrested later would then become the source of the connective stalk.

II. **PALTAUF** (1892) is the originator of the postfetal ingrowth theory. In an autopsy he could certify that, on the death of a patient after an operation for intratracheal goitre, a direct continual connection was displayed between the goitre lying intratracheally and exterior to the trachea in the space between the intact upper tracheal cartilaginous rings. **PALTAUF** also verified an unusually fast juncture between the thyroid lobes and the trachea (likewise **GÖDEL** and others) and explained the intratracheal goitre as being the result of an embryonal fixation of the thyroid primordium to the tracheal primordium, due to insufficient differentiation of the intervening mesenchyma before the glandular thyroid was equipped with a capsule. The fetal gland, in this case, should be firmly rooted to the perichondrium and interstitial membrane, but as **PALTAUF** emphasizes, the essential ingrowth of the thyroid tissue in the trachea presumably takes place much later, preferably during the age of puberty in connection with an increase in growth of the glandular thyroid. This abnormal tendency of benign goitre towards ingrowth might be explained by the fact that the peripheral glandular regions in the thyroid possess the most generative material and the greatest growth energy. In respect to the nodular goitre it is here that new nodes develop, grow up and remain loosely fixed to the main gland. **PALTAUF** thus concludes that when the perichondrium and interstitial membrane participate in the formation of the thyroid's capsule there are favourable conditions present for the ingrowth of newly formed parenchyma in the trachea. A number of authors adhere to this assumption (**BAUROWICZ**, **KAUFFMANN**, **DORN**, **ODERMATT**, **GÖDEL**, **PUHR**, **SCHWARTZ**, **RÜTER**, **OLBRYCHT**, and others).

**WEGELIN** (1939) has reported the result of an experimental investigation which confirms the ingrowth theory and which appears to be an excellent proof that the ingrowth of a benign form of goitre in trachea can occur. By feeding white rats on strumogen diet **WEGELIN** succeeded in developing a goitre which in some cases was diffuse and in others adenomatous. On examining the series of sections of larynx and cranial parts of the trachea it was revealed how the goitre grew backwards and nearly embraced the

oesophagus and the trachea. The ingrowth of the goitre tissue in the trachea was revealed in different stages among a number of animals (in two cases with severe stenosis of the lumen). There was no display of thyroid tissue in the submucosa in either the larynx or trachea in a control series of 12 animals with normal thyroids.

WEGELIN accordingly shares the ingrowth theory with PALTAUF but with the modification that the intratracheal goitre might presumably originate during the latter part of the embryonal stage by ingrowth into the trachea in connection with a strumous hyperplasia of glandula thyreoides. In an earlier work (1923) WEGELIN described an intratracheal goitre in two new-born babies. In both cases, in the intervening space between the ring cartilage and the first tracheal cartilage, he found a direct connection between the intratracheal goitre and a greatly enlarged thyroid gland (colloid goitre). In both these cases death had occurred some hours after birth through suffocation due to the intratracheal goitre. Two other cases of children with exterior goitre have been described by the same author. The children died from another cause. Microscopic investigation revealed thyroid glandular tissue submucously in the trachea with filaments of thyroid tissue penetrating the cricotracheal membrane. In these cases no macroscopic tumour had developed in the tracheal lumen (latent pre-stage to intratracheal goitre). In the control series of sections from 22 almost fully developed foetus and new-born children without struma congenita WEGELIN found thyroid tissue intratracheally in one case.

*Discussion:* Several facts have been put forward in support of the one or the other of the above theories. In cases where the intratracheal goitre was located in the vicinity of the tracheal bifurcation or on the level with or above the vocal chords its origin would undoubtedly be more nearly explained by vox BRUN's detachment theory or by the theory of HULTÉN related above. In respect to the intratracheal goitre with the usual localization its origin would also, in a number of cases, be due to partial or total detachment of parts of the thyroid primordium. A support for this assumption is that about one third of the published cases with intratracheal goitre are devoid of exterior goitre. One instance of this is the occurrence of a case with thyroid tissue intratracheally in WEGELIN's above reported control series of children lacking outer goitre. PRIESEL (1921) also found in one case of intratracheal colloidal goitre (with incipient cancerous

degeneration) that this goitre was well delimited and no connection with the main thyroid gland was to be found, not even on microscopic examination of the larynx and trachea. In some cases (ENDERLEN, MEERWEIN, LANGE and others), intratracheal goitre has been revealed without the abnormal fixation of the thyroid to the trachea described by PALTAUF and without any connection between the intra- and extratracheal thyroid glandular tissue. These authors maintain that in the said cases a complete detachment of some part of the thyroid primordium during the embryonal life should have given rise to the intratracheal goitre. In most cases however these observations have been made at operation, and for this reason no microscopic investigation of the membrane between the cricoid and the first tracheal cartilage could be performed. With a view to the same, these observations must be regarded as of limited value. ODERMATT (1920) and PUHR (1922) have each described a case where, on operating, no connection could be proved, but where, at the subsequent microscopic examination at autopsy one was clearly revealed. It has moreover been stated that the absence of post-operative recurrence supports the embryonal malformation theories, as the recurrence could probably take place if the intratracheal goitre had developed in accordance with PALTAUF's theory. DORN (1919) has published a case however with recurrence three months after the extirpation of a colloid goitre intratracheally (but judging from the description, remnants of the tissue may have remained after the first operation). Furthermore there is the possibility that the recurrence runs its course without clinical symptoms, that is to say, it is solely constituted of a microscopic growth of thyroid tissue in the submucosa of the larynx and the trachea. MEERWEIN (1908) reported a case of tracheal mucous glands found in an intratracheal goitre and concluded from the same that this goitre was the result of detached thyroid primordium. FALK (1936) states however that tracheal mucous glands, in such cases, are only enclosed within the growing intratracheal goitre after the fetal stage. His assumption is based on an investigation of the larynx and trachea of 21 adults where in not less than 9 cases he identified thyroid tissue intratracheally. Thus it would not seem that the relationship between the tracheal mucous glands and the intratracheal goitre is capable of contributing towards elucidating the origin. The facts which argue for the ingrowth theory have been brought forward in connection with the account of this theory.

From the above may be gathered that intratracheal goitre, in some cases, most probably occurs on the basis of a total or partial detachment of parts of the thyroid glandular primordium (v. BRUN, HULTÉN). In other cases the source might be explained in accordance with the ingrowth theory (PALTAUF, WEGELIN) which is supported by WEGELIN's experimental investigations.

The present author's case can be elucidated both by the ingrowth theory and that of HULTÉN. The intratracheal goitre was left-sided. A filament of goitre tissue running through the crico-tracheal membrane connected the outer and inner goitre with each other. In this case the intratracheal goitre was well delimited from the tracheal mucous membrane and its glands.

*Diagnosis:* There are cases of slight intratracheal goitre which can run their course without any appreciable symptoms. In cases with symptoms the picture of the disease is dominated by stenosis in the upper air passages. The symptoms are slight from the beginning and they develop gradually during a rather long time, due to the slow growth of the intratracheal goitre and the adaptability of the organism to the diminished supply of oxygen (polyglobulia and eosinophilia). The average time for the duration of the symptoms prior to the operation or exitus, in cases reported in the literature, is between 4 and 5 years. The first appearance of the symptoms often occurs at the time of puberty, but stenotic symptoms are manifest in rare cases among new-born children and then, as a rule, in connection with congenital goitre. The earliest discomfort usually consists in dyspnea, and this is sometimes accompanied by a feeling of the presence of foreign bodies in the throat and an irritating cough. Among adult women one gets a hint towards the diagnosis from the fact that the stenotic symptoms sometimes increase premenstrually to a considerably greater extent than is the case with an extratracheal struma (HOFFMAN, SUCHANEK). The trouble as a rule increases considerably in connection with pregnancy also (WURSTER, MAIER, BUNDSCHUH, VACHER & DENIS), just as in this present reported case. The physiologic enlargement of the thyroid during pregnancy, which is said to occur in 30—90 % (NORRMAN) and which is presumably due to pure hyperplasia (JAVERT) can, in such cases, contribute towards increase of the stenosis. In later stages of the course of the disease there occur attacks of suffocation, mostly during the night. A disposition exists for catarrhal conditions of the trachea and bronchi and the stenotic troubles become worse

because of the swelling of the mucous membrane and the accumulation of secretion. By degrees the stridor begins, in most cases first of an expiratory and later also of an inspiratory character. Hoarseness may develop and it is caused either by catarrh of the mucous membrane or through disturbance of the motoric action of the vocal chords. Cases with the highest degrees of stenosis are accompanied by cyanosis and inspiratory suppression of the thorax.

In respect to laryngoscopy which, as a matter of routine, should be performed prior to every operation for goitre to exclude the possibility of eventual paresis of *Nervus recurrens*, one must, in connection with goitre patients with severe stenotic symptoms pay attention to the region below the vocal chords where an intratracheal goitre takes the form of a rounded, even curvature inwards in the subglottic space. One should avoid the use of a vascular constructive agent when handling the mucous membrane in an investigation as the reactive hyperemia and swelling when the preparation has ceased to act can invoke a fateful constriction of the small part of the lumen which still remains. DORN (1919) calls attention to this condition and in the above described case it is certainly not impossible that this contributed towards the speedy unfortunate issue.

The roentgen picture can be typical in some cases. Earlier, roentgen investigations with positive results in intratracheal goitre have been made only 5 times (HOFFMANN, ODERMATT, HEINDL, HULTÉN, BEESON). In these cases likewise in that of the present author (see fig. 1) one finds constriction of the tracheal air passages in the shape of a rounded shadow of a tumour with a distinct outline (PACK and CRAVER). As distinguished from the constriction in an extratracheally situated tumour which conveys a longish, spool-shaped impression, the intratracheal goitre casts a more offset, rounded and delimited shadow without dislocation of the trachea (unless an exterior goitre simultaneously brings about a dislocation).

If a patient has undergone strumectomy for ordinary extratracheal goitre owing to stenotic trouble, and this remains after the operation, or reappears subsequently, one must be suspicious of intratracheal goitre. Several such cases are described in the literature (BAUROWICZ, ODERMATT, LANGE, WURSTER, MAIER, HEINDL, HULTÉN, WESSELY, HAARDT and others). In certain of these cases one can assume the possibility that the intratracheally

situated thyroid tissue had sustained a compensatory hypertrophy (deputy organ). This seems to be particularly acceptable in cases in which the stenotic symptoms increased some time after the operation.

The case described by HULTÉN is instructive in this respect and also from a therapeutic point of view. A brief account of the same is given in the following:

A girl 13 years of age was operated upon 1 year earlier for a goitre (extratracheal) of large size (450 g). It was mainly of diffuse colloidal type with considerable stenotic trouble. After the operation a slight expiratory stridor, trifling however in comparison with the condition prior to the same. Laryngoscopy, normal conditions. The patient returned to the hospital one year after the operation with acute symptoms in the form of hoarseness, cough and increasing respiratory trouble. Twelve hours after the arrival the respiratory difficulties were suddenly augmented, and for this reason tracheotomy was performed. *Roentgen investigation:* Trachea: From behind the left, an inward-curved tumour about the size of a dove's egg with rounded, distinct outline. — The tumour could be inspected through the tracheotomic opening with the aid of a laryngoscope. It was round, broad-based, of the size of a walnut and covered with normal, slightly reddish mucous membrane. *Diagnosis prior to the operation:* Intratracheal goitre. *Operation:* Local anaesthesia. A 4 cm long incision through the anterior wall of the trachea. The mucous membrane was anaesthetized with pantocain spray. The tumour was rather fixed to the submucosa but the delimitation was better towards the cartilage. Cannula in the lower angle of the wound with tamponade encircling the same, to prevent blood from running down into the trachea. Tamponade after the operation against the tumour bed. The tamponade and the cannula removed after 2 days. The patient was dismissed in a healthy condition after 14 days. On reexamination 2½ years later she was well and there was no sign of a recurrence. *Microscopic investigation:* The intratracheal goitre reveals the picture of a colloid goitre (with a slight touch of the Basedow type).

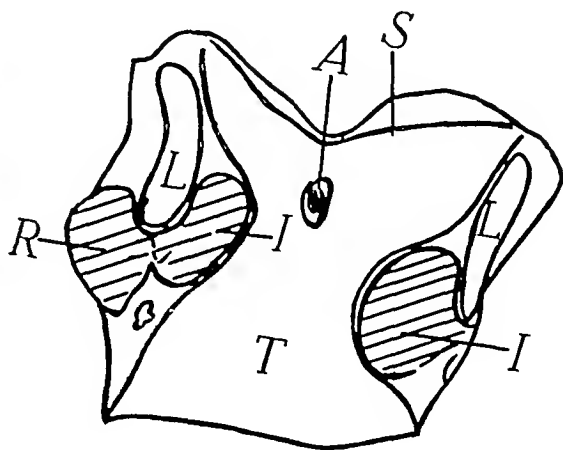
*Differential diagnosis:* Several of the different forms of tumour, some of them rare, in larynx and trachea, can call forth differential diagnostic questions. *Papilloma* generally occurs among children and younger persons. It is recognized as a rule in performing laryngoscopy, likewise the *fibroma* which is most frequently stalked in contrast to the broad-based goitre. The *enchondroma* and *osteoma* are characterized by their hardness which can eventually be determined by using the probe. The roentgen investigation reveals the visible collection of chalk, and as regards the enchondroma, also the oft occurring small cystic formations



Fig. 1. Intratracheal goitre (I) is distinctly delineated and constricts the tracheal lumen (T). Barium mixture in the oesophagus (B). Anterior neck contour (D) is curved forward by the extratracheal goitre.



2 a.



2 b.

Fig. 2. The subglottic part of the larynx and the upper part of the trachea (incised in the posterior left region). Retrotracheal adenoma (R) is connected with the intratracheal goitre (I) between the lamina cartilaginosa cricoidis (L) and the first tracheal cartilage. Tracheal lumen (T) greatly narrowed. S = vocal chords. A = traumatic injury at autopsy.

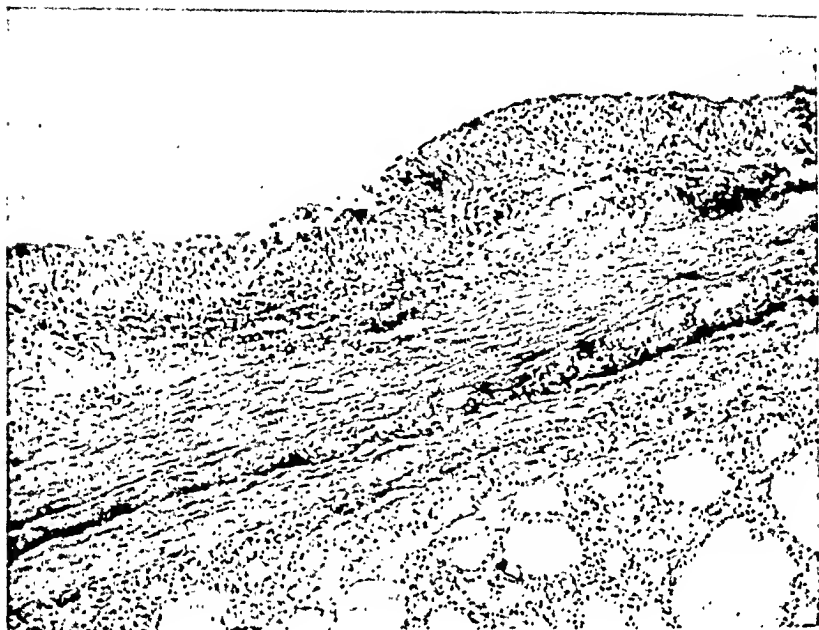


Fig. 1. The intratracheal goitre is well delimited from the tracheal mucous membrane. In the mucous membrane there are signs of inflammation with distended vessels and cellular infiltration.

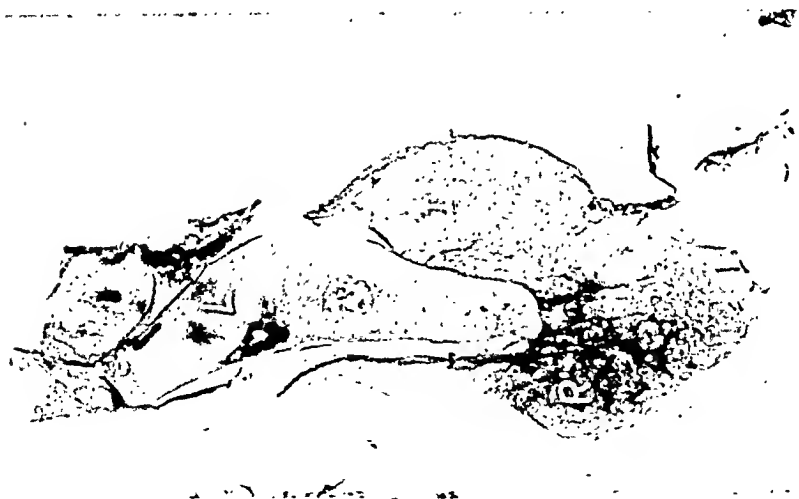


Fig. 3. Section of the same region as shown in Fig. 2. R = retrotracheal adenoma. I = intratracheal goitre. L = Lamina cart. cric. T = the first tracheal cartilage.



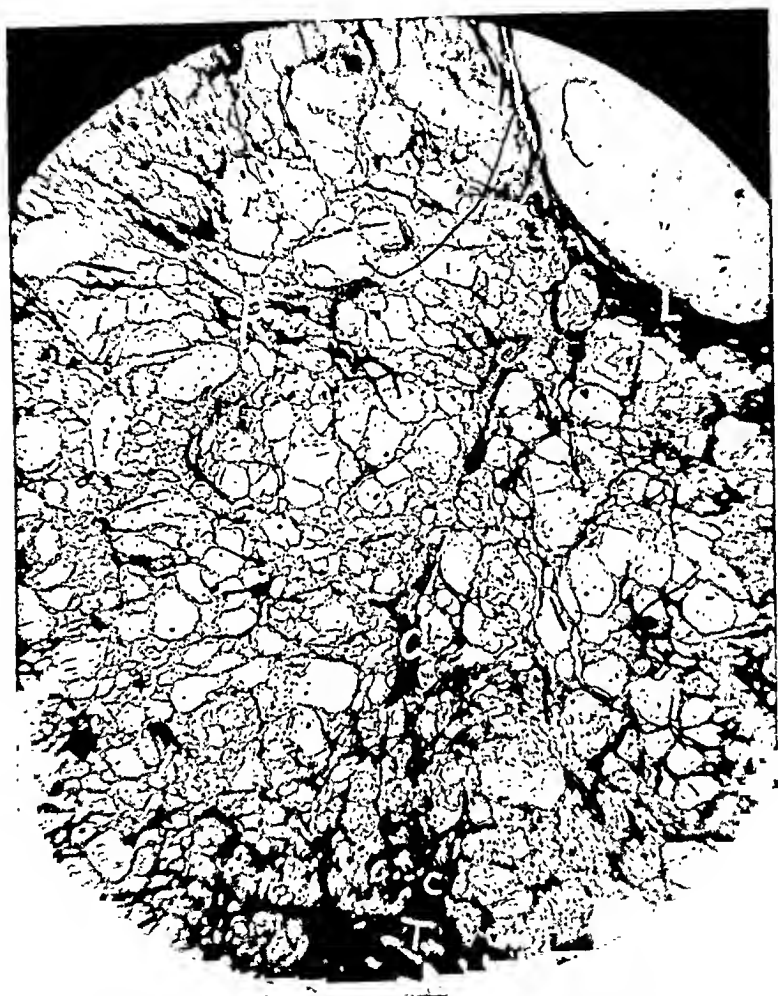


Fig. 5. Section of the region between cartilago cricoides (L) and the first tracheal ring (T). The ericotracheal membrane (C) penetrated in several places by goitre tissue which connects the outer and inner goitre with each other.



Fig. 6. Section of the cricotracheal membrane a few millimetres adjacent to the direct penetration. Small colloid follicles interspersed within the membrane (in the series of section these islets had probably turned out to be filaments of struma tissue which penetrated the membrane).

(PACK and CRAVER). The *adenoma*, *lipoma*, *lymphoma* and *amyloid "tumours"* (rare) are much more difficult to distinguish from the intratracheal goitre, especially if there is no goitre exteriorly. *Sarcoma* in its earlier stages displays a smooth and even surface. It is broadbased as a rule, and on this account can be mistaken for an intratracheal goitre. The latter however has a considerably more constant localization. It is generally to be found in the subglottic space. *Carcinoma* appears preferably at higher ages in contrast to the intratracheal goitre and unlike the last mentioned, occurs more often among men. The diagnostics of *tubercular* and *syphilitic* infiltrations are obtained from the anamneses, physical finds, serologic tests and laryngoscopy, as well as by means of roentgen examination (calcification of the laryngeal cartilage which is unlike the calcification due to age — WÖRNING). The perichondritic abscess is characterized by its flabby fluctuating consistency. The thymus tissue intratracheally among children can be included as a diagnostic possibility though more as a unicum (one case in the literature — FALK 1936). It is remarkable that several patients with intratracheal goitre are treated for asthma bronchiale for a long time before the right diagnosis is obtained (BEESON).

*Treatment:* As a rule one is advised against internal therapy and roentgen treatment as being ineffective or bringing about only temporary effect. NEUMAYER (1904) however considers that he had achieved a lasting effect through the administration of an iodine preparation in two cases.

The treatment in cases with stenotic symptoms will thus be operative. A simultaneous pregnancy constitutes no contra-indication towards an operation but, on the contrary, increases the indication, because the stenotic troubles augment by degrees during the course of the pregnancy and culminate in connection with partus when more dangerous conditions are liable to be involved.

The intratracheal goitre is extirpated pertracheally or via laryngo-fissure. Several authors dissuade from endoscopic extirpation owing to the difficulty involved in controlling the bleeding from the often richly vascularized goitre, and in handling the post-operative swelling. These complications can then render a tracheotomy necessary (VON BRUN, SEIFERT and others). Endoscopic removal with good result has been accomplished especially in cases where the goitre was located on a level with or above

the vocal cords (MEYER and CAPPON, GERMAN, BALDENWECK et LEVY-DEKER, ALPÄR).

When operating pertracheally one is advised to make the longitudinal incision in the trachea so long that it reaches well below the intratracheal goitre. This facilitates assistance in case of eventual bleeding, a cannule can be placed in the lower corner of the wound and a tamponade made around it. On opening the trachea the incision should be performed without injury to the intratracheal goitre, as then serious hemorrhages can be involved (THEISEN). The removal of the goitre can sometimes meet with difficulties owing to the intimate junction with the tracheal mucous glands, but one tries to spare as much of the mucous membrane as possible through submucous extirpation (SUCHANEK). The tamponade against the bed of the goitre is sometimes necessary, likewise the cannule which is allowed to remain a day or two. Primary suture of the trachea has been executed by HUG (1923) after coagulation of the tumour bed by diathermy, without any post-operative complications.

In cases where there has been an exterior goitre with stenotic symptoms mainly due to an intratracheal goitre, the manner of proceeding has been different. BAUROWICZ (1898) performed strumectomy of the outer goitre and inserted a tracheal cannule in the first stage and after a satisfactory healing was accomplished, the intratracheal goitre was extirpated. As a tracheotomic opening leading up to the large wound-hole after strumectomy seems to be far from pleasing, it has been found more expedient in some cases to remove only the isthmus part of the outer goitre and extirpate the intratracheal goitre firstly, thus leaving the eventual ectomy of the external goitre until later. This is obviously provided that the disease picture is rightly interpreted prior to the operation and that the intratracheal goitre has been comprehended as the main cause of the stenotic symptoms.

*Prognosis:* In cases where the operation can be performed at an early stage before the organs of respiration and circulation are injured, the mortality seems to be very low. In the collocated material from the literature the operation mortality is however rather high (7/56 of operated cases with reports as to the operational issue) although such operational methods as electropuncture and dilatation treatment (as each was once used with an unfortunate issue as the natural result) are excluded. In several of these cases with disastrous outcome the operation was per-

formed very late and under unfavourable circumstances. The cause of death has most frequently been pneumonia (erysipelas in the tracheotomic wound in one case). Recurrence seldom takes place after extirpation of intratracheal goitre. DORN (1919) has described one case of recurrence however, a quarter of a year after the operation. With reference to the prognosis for operation during pregnancy, the few cases reported in literature do not warrant any conclusions (THEISEN, WURSTER, GROSSMANN, BUNDSCHUH). The pregnancy is reported to have run its course without abortion, with the exception of one case (THEISEN) where the patient died after the operation. The frequency of abortion in connection with ordinary goitre operations during pregnancy is said to be low (MEANS).

### Summary.

In the case of a woman who of recent years had suffered from increased breathing difficulty which became speedily aggravated in connection with pregnancy, the probable diagnosis, intratracheal goitre, was pronounced with the aid of the anamnesis, laryngoscopy and roentgen investigation. Exterior goitre was also present. The patient died during an attack of suffocation in spite of intubation and other resuscitative measures being taken. In connection with the same, attention is called to the risk of a fatal reactive hyperemia and swelling in respect to intratracheal goitre after treatment with vascular constrictive agents in laryngoscopy. Intratracheal goitre was certified at autopsy. Direct connection between the intratracheal and extratracheal goitre via the membrane between the cricoid cartilage and the first tracheal cartilage ring could be verified. The genesis is discussed on the basis of earlier published theories. In respect to this present case it may be assumed that the intratracheal goitre can have originated either through the ingrowth of strumal tissue or by an embryonal incomplete detachment of a part of the thyroid primordium. The diagnosis and therapy are reported on the basis of earlier published cases in literature.

### Zusammenfassung.

Bei einer Frau, die in den letzten Jahren zunehmende Atembeschwerden gehabt hatte, welche sich bei eingetretener Schwang-

gerschaft rasch verschlimmert hatten, wurde an Hand der Anamnese, der Laryngoskopie und des Röntgenbefundes die Wahrscheinlichkeitsdiagnose intratracheale Struma gestellt. Ausserdem lag ein äusserer Kropf vor. Die Kranke stirbt trotz Intubation und Belebungsversuchen bei einem Erstickungsanfall. Im Zusammenhang hiermit wird die Gefahr einer verhängnisvollen reaktiven Hyperämie und Schwellung nach Behandlung mit gefässkontrahierenden Mitteln bei der laryngoskopischen Untersuchung bei Fällen von intratrachealer Struma betont. Bei der Sektion bewahrheitete sich die Diagnose intratracheale Struma. Eine direkte Verbindung zwischen der intratrachealen und der extratrachealen Struma durch die Membran zwischen Ringknorpel und erstem Trachealknorpelring konnte nachgewiesen werden. Die Genese wird an Hand früher aufgestellter Theorien besprochen. Bei dem hier vorliegenden Falle kann man sich denken, dass die intratracheale Struma entweder durch Einwachsen von Kropfgewebe oder embryonal durch unvollständige Abschnürung eines Teiles der Schilddrüsenanlage entstanden ist. Über Diagnose und Behandlung der intratrachealen Struma wird an Hand von früher im Schrifttum beschriebenen Fällen berichtet.

### Résumé.

Chez une femme ayant présenté au cours des dernières années des troubles dyspnéiques progressifs, qui s'étaient aggravés rapidement depuis le début d'une grossesse, on pose le diagnostic probable de goitre intratrachéal en s'aidant de l'anamnèse, de la laryngoscopie et de l'examen radiologique. Il y avait également un goitre externe. La malade décède lors d'une crise d'étouffement en dépit de l'intubation et d'essais de réanimation. A ce propos l'auteur souligne le risque d'une réaction hyperémique et d'une tuméfaction fatale, dans les cas de goitre intra-trachéal, à la suite de l'application de médicaments vasoconstricteurs aux fins d'examen laryngoscopique. L'autopsie permit de vérifier le diagnostic clinique. On put mettre en évidence une communication directe entre les deux goîtres interne et externe au travers de la membrane unissant le cartilage cricoïde au premier anneau cartilagineux de la trachée. La pathogénie fait l'objet d'une discussion basée sur des théories avancées autrefois. Dans le cas présenté on peut penser ou bien que le goitre interne s'est produit par la pénétration de tissu goitreux dans la profondeur, ou bien

qu'il est dû à la séparation incomplète, survenue au stade embryonnaire, d'une partie de l'ébauche thyroïdienne. Le diagnostic et le traitement du goitre intratrachéal sont passés en revue sur la base de cas décrits antérieurement dans la littérature.

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## Synovectomy in Cases of Chondromalacia of the Patella.

By

CARL HIRSCH, M. D.

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All those who have had occasion to work on joints and who have opened joints of adult persons, have surely noted frequent changes in the cartilage. The older the patient is, the less often the cartilage of the joints is intact.

With regard to the knee-joint, and specially the femoro-patellar joint, several observers (HEINE, SILFVERSKIÖLD) have published data, showing the number of cases with degenerative changes at different ages.

We have to ask ourselves how many of all these cases do really have trouble with their knee-joints. According to SILFVERSKIÖLD about 100 % of persons in the higher age-groups should have knee disabilities if anatomic-pathologic changes in the cartilage were the only cause. Our clinical experience does not confirm this. The disabilities seem to be in proportion to the strain which is put on the affected joint.

Since POMMER in 1913 wrote his famous book on the changes of cartilage in cases of arthrosis deformans, and HEINE in 1926 made his extensive anatomic-pathologic frequency tests on the occurrence of cartilage degeneration in different joints, our attention has been mainly directed to the degenerated cartilage as the cause of impairment of function.

What is then more natural than a therapy which aims at removing the altered cartilage?

In this country it was ALEMAN who was the first to use this treatment for Chondromalacia patellae, and the results have,

generally speaking, been good. STIG KARLSSON has done follow-up examinations which proved that. KARLSSON's examinations and those which have been made in other countries are, however, clinical examinations. As far as I know no examinations have been made in which the patella was actually inspected some time after the removal of its cartilage.

Some surgeons believe that after they have removed the patellar cartilage some sort of replaced cartilage-like tissue takes place on the patella. ALEMAN, for instance, was very particular about removing the cartilage in a special way so as to permit regeneration.

But is it definite that it is the degeneration of the cartilage which is responsible for the disability inasmuch as there is a wide discrepancy between the number of people showing cartilage degeneration and the incidence of disability? This is particularly in elderly people where the changes are very pronounced.

HULTÉN and GELLERSTEDT have shown by tests with animals, that if fine particles of cartilage were injected into a joint, there occurred a reaction, a synovitis with hyperemia and edema of the synovial membrane. The free particles of cartilage, according to these scientists, produce an irritation in the joint of the type which is often found *e. g.* in knee joints with chondromalacia or a more general arthrosis deformans.

In other words, this means the disability, which the patient has, is due to a reaction in the synovial membrane caused by an irritation from loose particles of cartilage.

HULTÉN and GELLERSTEDT have also shown that the synovial membrane has the capacity of resorbing the free particles of cartilage. If this theory is applied to Chondromalacia patellae or to general destruction of cartilage, one might say that an increasing strain on an articulation with soft and fringed cartilage means an increased risk that particles of cartilage may be knocked off causing a synovial reaction.

The logical consequence of this reasoning is that the risk that the degenerative parts of cartilage will loosen is diminished either if the patient spares his knee or, at least temporarily, if the malacic centre in the cartilage is removed.

In cases of chondromalacia it is usual to start by ordering the patient to spare his knee. Only when disability is severe and when hydrops occurs repeatedly, is it usual to propose an operation.

Chondromalacia as well as degeneration in the cartilage usually

develop slowly, and we can be pretty sure that there are particles of cartilage which have been loosened which the synovial membrane has made innocuous by resorption. We may now ask: Why does the synovial membrane so to speak lose its capacity of resorbing particles of cartilage? Is this the consequence of the malacia spreading to such a degree as to exceed the resorptive capacity of the synovial membrane, or does the synovial membrane lose this capacity for other reasons? Or is the synovitis due to some other cause? We do not know. We have often seen that there is no relation between the extent of the malacia or its appearance and the symptoms.

If we uphold the theory that the loose particles of cartilage cause the synovial reaction, we have to ask why hydrops or generally speaking synovitis does not occur in all the cases or anyhow more frequently when there are free cartilage-covered bodies in joints and where the cartilage is permanently in contact with the synovial membrane. Perhaps the loose cartilage, in order to cause a synovial reaction, has to be in a special degenerative condition.

We cannot get away from the thought that perhaps during the last few years we have been fixing our attention on the cartilage and have paid less attention to the pathologic and physiologic proceedings in the synovial membrane.

After the excision of a patella cartilage it often takes several months before the patient's knee-joint functions well. What happens then to the patient's patella? Does the cartilage which has been left remain in the joint?

Some patients came back to us with complaints, some of them after having had no disability for some time. In some of those cases we performed an extirpation of the patella (FRIBERG). In the patellas removed in this way there was usually no cartilage or only malacic remnants. In some cases there were obvious marks of the knife though several years had elapsed since the operation. We could in no case find any regeneration of cartilage.

In order to find out the reaction on the cartilage of the patella I performed a chondrectomy on two dogs two years ago. I then performed arthrotomy about three months after the first operation, and also recently two years after the operation. At the second arthrotomy three months after the first operation I noticed no changes. There were obvious marks of the first opera-

tion, just as if the cartilage had recently been cut into. After two years there was practically no cartilage left on the patella nor on the femoral condyles and the bare bone was visible. There were no signs of either synovitis or regeneration of cartilage. I used big Rottweiler dogs.

As far as I could see, the dogs had no trouble with their knees, no limping or swelling. They all appeared to have sound knees. This led me to expect normal cartilage in the knee-joints. The dogs had not been spared but had had normal exercise during the last two years. No diminution in their motor ability was noticed.

Due to the uncertainty in the connection between damaged cartilage and the reaction of the synovial membrane, to the slow course of a case of excision of cartilage, and to the uncertainty with regard to the possible consequences of the excision and also due to the experience that the patient would not get new cartilage, I have in two cases tried a partial excision of the synovial membrane in chondromalacia of the patella, synovectomy being an operation which is often made successfully in cases of chronic synovitis.

One of the cases was a thirty-six years old artist with a typical two years' history of Chondromalacia patellae with recurring hydrops, the last year with constant exudation and considerable dysfunction of the knee. The operation showed that the greater part of the cartilage of the patella was completely destroyed, as well as part of the cartilage of the femoral condyles. In the joint there were signs of synovitis. There were also free bodies of degenerated cartilage, apparently originating from the patella. The free particles of cartilage were removed, and the synovial membrane in the recessus suprapatellaris was resected. The histo-pathologic examination showed: Chronic hyperplastic synovitis. After five weeks the patient was free from symptoms, showed normal agility and no hydrops. The operation took place a year ago, and the result has persisted.

The other case is a twenty-eight years old worker with nearly a year's history of disability due to a knee trauma. His trouble consisted partly of chondromalacia of the patella and partly of an injury of the medial meniscus. The patient suffered from a permanent synovitis with a well-developed hydrops. During the operation I found a movable but not detached meniscus. There was also pronounced chondromalacia with deep fissures in the cartilage of the patella. The synovial membrane in the recessus supra-

patellaris was resected. The histo-pathologic examination showed: Chronic hyperplastic synovitis. After three months the patient showed no more symptoms, had full mobility and no hydrops.

Inasmuch as the trouble caused by Chondromalacia patellae often resolves under conservative treatment I think it would be wise to operate only on those who have persistent trouble including recurrent hydrops. In these cases an immediate synovectomy might be the easiest means of helping the patient. If there is no result there is always the possibility of operating on the patella, that is a chondrectomy or in advanced cases a total extirpation of the patella.

### Summary.

The author has operated two cases of chondromalacia of the patella by means of synovectomy. The patients were soon free from trouble. Control examination a year after the operation showed functionally good results. The author warns against extensive indications for chondrectomy. In the first instance conservative treatment should be tried. An operation should be performed only if there is much trouble and relapsing hydrops appears. The author asks whether synovectomy ought not to be tried in such cases.

### Zusammenfassung.

Verf. hat zwei Fälle von Chondromalacia patellae mittels Synovektomie operiert. Die Kranken wurden rasch beschwerdefrei. Nachuntersuchung ein Jahr nach der Operation zeigte funktionell gute Ergebnisse. Verf. warnt vor allzu weiten Indikationen für die Chondrektomie. An erster Stelle soll konservative Behandlung versucht werden. Nur bei grossen Beschwerden und rezidivierendem Erguss ist eine Operation vorzunehmen. In solchen Fällen kommt nach Verf. ein Versuch mit einer Synovektomie infrage.

### Résumé.

L'auteur a opéré par synoviectomie deux cas de chondromalacie rotulienne. Les examens de contrôle un an après l'intervention montrèrent un bon résultat fonctionnel. L'auteur déconseille fortement d'étendre les indications de la chondrectomie. En premier lieu il faut essayer du traitement conservateur. C'est seulement lors de troubles graves et d'hydarthrose récidivante que l'opération doit être entreprise. En pareil cas l'auteur se demande s'il ne convient pas de tenter la synoviectomie.

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## **A Clinical Study of the Hematological Changes in Acute Obstruction of the Small Intestine.**

By

LEIF EFSKIND.

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### **Introduction.**

The pathogenetic basis for the acute intestinal obstruction syndrome is far from clear, even though the last few years' patho-physiological investigations have given added orientation to many of its factors. These additions have given rise to so many new problems in the pre- and postoperative treatment of patients with acute intestinal obstruction that if all these factors were to be taken care of the preoperative treatment in particular would become so complicated and of such long duration as to be clinically impracticable. Thus it is of practical importance to isolate the chief pathogenetic factors of the causes of death in acute intestinal obstruction and adopt the treatment indicated.

Experiments (MOON and MORGAN) show a similarity in the patho-physiological findings in acute intestinal obstruction and experimental shock, particularly in the dehydration which occurs. This similarity has been demonstrated therapeutically by the prolongation of life of animals with experimental obstruction by administration of large amounts of water and sodium chloride (HARTWELL and HOGUET) although this treatment did not solve the therapeutic problems which arise. Judging from the literature the serum proteins have seldom been noted in clinical studies, although they play a dominant part in the clinic and pathogenesis

of shock as an index of the blood's osmotic pressure and fluid balance in the body.

### Clinical Findings.

This study includes 30 patients with acute intestinal obstruction of the small bowel. All except 2 of these (6, 16) were treated surgically. Hematological examinations were made preoperatively and postoperatively and are shown in the table. Of the postoperative findings only the lowest figures are shown, with the addition of the results of one examination later in the course of the disease. According to the preoperative hematological findings and the duration of the disease the cases are divided into three groups:

I.	Clinical symptoms of	3—12 hours' duration	11 pat.
II.	»	» 13—72 »	11 »
III.	»	» more than 72 hours duration	8 »

Since there is no well defined boundary between the hematological findings in the different groups, the division is necessarily somewhat arbitrary.

It is evident from the table that the basic disease does not determine the grouping. One might anticipate that the objective strangulations, incarcerated hernias, would be the first to appear for treatment. However, only 3 of the 11 cases in the study are in Group I.

The preoperative hematological findings in the first group were almost normal except for minimal signs of dehydration in a few cases. The postoperative hematological reaction was slight except in one case (9). This coincident with the fact that the operation as a rule was simple and of short duration. In only 2 cases (1 and 4) was the bowel included in the operative procedure, and the postoperative course was without signs of peritoneal irritation. The one patient (9) who had a marked reaction, developed lung embolism and received protracted heparin treatment. The regenerative phase for the serum proteins was short indicating that the productive organs were intact. The electrolyte balance showed no definite pathologic changes.

Group II showed more heterogeneous hematological findings both in the pre- and postoperative phase. Determinations of erythrocytes and hematocrite showed uniform signs of dehydration. In many cases after the first 24 hours the serum protein



values were found to be reduced, although upon admission this condition was masked by the dehydration and became apparent after the fluid balance was restored during the preoperative treatment (17). In one case (21) a marked anemia was demonstrated. At operation this was found to be the result of a large extravasation of bloody fluid in the strangulated bowel and peritoneum.

The postoperative hematological reaction depended upon the type of operative procedure used, the complications which may have occurred and the preoperative protein status. When the latter was low and the patient's general condition was reduced over a protracted period, so the existence of a chronic hypoproteinemia might be assumed (16), the reaction was marked and the regenerative process slow despite the fact that the operative procedure was minimal. In cases in which lesser operative interventions in the intestine, such as inversion or excision of ring-like areas of constriction suspected of gangrene or ileostomy, the immediate postoperative reaction was comparatively slight. When extensive bowel resections were performed (19), the immediate reaction was marked. The duration of the regenerative phase in this group depended chiefly upon whether or not ileostomy was performed. The patients with ileostomy were more difficult to bring into protein balance because of the accessory losses involved. Clinical symptoms of peritonitis did not occur in this group.

Group III showed the same basic changes as the group discussed above. However, the postoperative protein values were as a rule somewhat lower, and the fractional deviations were more serious. The immediate postoperative fall in the protein values was great and in these patients who died of peritonitis (23, 24, 25, 26) there was a continuous, increasing hypoproteinemia. The remainder of the patients in this group had a long regenerative phase. In spite of parenteral administration of large amounts of proteins the hypoproteinemia persisted for weeks and was a sign of the serious disturbance in protein metabolism present in the organism. In these patients with diffuse peritonitis the hematologic status progressed to a condition of peritonitic shock. Two of these patients (24, 25) had edema of the ankles.

### Comment.

The chief purpose of this study was to relate the clinical and hematological status to the duration of the disease in order to

No. Age	Sex	Durat. (Hours)	Diagn.	Local.	Operation	Peritoneal irritation	Edema	Date	Group
1 23	♂	12	Adhaes. perit.	Low ileum	<sup>12</sup> / <sub>10</sub> Liberat. <sup>2</sup> / <sub>10</sub> ileostomia	÷	÷	<sup>22</sup> / <sub>10</sub> <sup>25</sup> / <sub>10</sub> <sup>1</sup> / <sub>11</sub>	
2 38	♀	12	"	"	<sup>2</sup> / <sub>5</sub> Liberat.	÷	÷	<sup>2</sup> / <sub>1</sub> <sup>2</sup> / <sub>3</sub>	
3 24	♀	10	"	"	<sup>2</sup> / <sub>1</sub> Liberat.	÷	÷	<sup>2</sup> / <sub>1</sub> <sup>2</sup> / <sub>5</sub>	
4 24	♀	10	Corp. alien. intest.	"	<sup>2</sup> / <sub>1</sub> Remotio pr. lap.	÷	÷	<sup>2</sup> / <sub>5</sub> <sup>11</sup> / <sub>11</sub>	
5 15	♀	8	Strang.	"	<sup>2</sup> / <sub>1</sub> Liberat.	÷	÷	<sup>2</sup> / <sub>1</sub> <sup>2</sup> / <sub>1</sub>	
6 81	♀	4	Hern. incarc.	"	<sup>2</sup> / <sub>1</sub> Taxis.	÷	÷	<sup>2</sup> / <sub>3</sub> <sup>1</sup> / <sub>5</sub>	
7 72	♀	4	"	"	<sup>2</sup> / <sub>1</sub> Operat. radic.	÷	÷	<sup>2</sup> / <sub>1</sub> <sup>2</sup> / <sub>1</sub>	
8 74	♂	8	Adhaes. perit.	"	<sup>22</sup> / <sub>1</sub> Liberat.	÷	÷	<sup>22</sup> / <sub>1</sub> <sup>21</sup> / <sub>1</sub> <sup>2</sup> / <sub>3</sub> <sup>2</sup> / <sub>3</sub>	
9 32	♀	10	"	"	<sup>1</sup> / <sub>11</sub> Liberatio	÷	÷	<sup>2</sup> / <sub>11</sub> <sup>12</sup> / <sub>11</sub> <sup>12</sup> / <sub>10</sub>	
10 70	♀	3	Hern. incarc.	"	<sup>12</sup> / <sub>11</sub> Satura intest.	÷	÷	<sup>14</sup> / <sub>1</sub> <sup>14</sup> / <sub>1</sub> <sup>21</sup> / <sub>1</sub>	
11 34	♀	12	Adhaes. perit.	"	<sup>22</sup> / <sub>5</sub> Liberatio	÷	÷	<sup>22</sup> / <sub>1</sub> <sup>21</sup> / <sub>5</sub> <sup>1</sup> / <sub>5</sub> <sup>2</sup> / <sub>10</sub>	
12 57	♂	24	Strang.	High ileum	<sup>11</sup> / <sub>9</sub> ileostomia	÷	÷	<sup>11</sup> / <sub>9</sub> <sup>21</sup> / <sub>9</sub> <sup>21</sup> / <sub>9</sub>	
13 56	♀	24	Hern. incarc.	Low ileum	<sup>15</sup> / <sub>1</sub> Satura intest.	÷	÷	<sup>13</sup> / <sub>1</sub> <sup>16</sup> / <sub>1</sub> <sup>8</sup> / <sub>3</sub>	
14 52	♀	48	Strang.	High ileum	<sup>27</sup> / <sub>9</sub> Liberat.	÷	÷ <sup>55</sup> / <sub>9</sub>	<sup>27</sup> / <sub>9</sub> <sup>2</sup> / <sub>9</sub> <sup>14</sup> / <sub>10</sub>	
15 70	♀	24	Hern. incarc.	Ileum term.	<sup>27</sup> / <sub>10</sub> Herniotom. pr. lap.	÷	÷	<sup>27</sup> / <sub>10</sub> <sup>7</sup> / <sub>11</sub> <sup>11</sup> / <sub>11</sub>	
16 74	♀	48	"	Low ileum	<sup>4</sup> / <sub>11</sub> Taxis	÷	÷	<sup>4</sup> / <sub>11</sub> <sup>7</sup> / <sub>11</sub>	

Tot. Prot.%	Alb.%	Glob.%	Nonprot. Nitrog. Mgr.%	Hgb.%	Red blood cells	Hemato- crit	Clorid M.eq.	Alcal reserv.
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## I.

7.12	4.87	2.25	45	104	5.15	41	98	64
6.44	4.01	2.43	50	94	4.5	38	100	58
6.83	3.96	2.87	32	102	5.1	45	93	60
7.24	5.01	2.23	40	103	5.3	42	100	62
6.72	4.41	3.31	35	100	5.05	41	102	60
7.41	5.82	1.79	40	106	4.95	30	99	63
5.51	4.05	1.66	45	92	4.7	37	100	61
7.06	4.91	2.15	35	98	5.1	41	100	61
7.50	3.98	3.52	30	104	5.3	41	101	63
7.17	5.37	1.80	27	100	5.14	41	101	62
6.78	4.98	1.80	25	98	5.0	42	99	60
7.84	5.32	2.52	30	96	4.95	38	96	62
7.52	5.08	2.44	25	92	4.8	38	97	59
7.48	4.06	3.42	40	95	4.5	34	102	55
7.12	4.32	2.80	35	96	4.6	36	100	56
8.27	4.87	3.40	45	97	4.68	35	93	51
7.30	4.78	2.52	40	93	4.5	35	94	54
6.79	4.13	2.66	38	90	4.5	36	96	58
7.0	5.21	1.79	26	94	4.7	38	98	57
7.24	4.91	2.38	40	104	5.1	40	94	66
5.76	3.71	2.05	23	107	5.2	43	85	62
6.40	3.89	2.51	30	99	5.0	41	99	58
7.16	4.88	2.18	38	116	5.6	36	88	50
6.00	3.02	2.98	40	90	3.6	41	82	61
6.70	3.74	2.26	35	100	4.88	39	93	60
6.17	4.12	2.05	34	125	6.04	50	98	52
6.04	3.91	2.13	26	109	5.1	46	102	47
6.14	3.96	2.18	39	100	4.96	41	95	54
6.10	4.31	1.79	27	102	4.84	36	93	56

## II.

6.44	3.67	2.47	50	106	5.4	46	94	64
5.99	3.28	2.71	45	90	4.9	41	97	56
5.93	2.66	3.27	39	88	4.4	38	84	52
6.88	4.05	2.33	27	104	5.26	44	100	58
6.62	3.79	2.33	33	98	4.9	40	102	60
7.44	4.03	3.41	36	87	4.47	33	93	58
6.11	4.01	2.10	30	97	5.07	41	93	44
5.86	3.96	1.80	34	89	4.08	39	110	56
7.03	4.21	2.82	30	99	5.0	40	100	53
8.16	4.74	3.41	26	110	5.44	37	94	57
7.79	4.57	3.22	41	100	5.2	38	93	60
6.91	3.95	2.96	29	72	3.4	24	96	57
6.06	4.00	2.06	40	100	4.9	38	95	54
5.24	3.41	2.23	36	84	4.5	34	98	55

No. Age	Sex.	Durat. (Hours)	Diagn.	Local.	Operation	Peritoneal irritation	Edema	Date
17 77	♀	48	Adhaes. perit.	Low ileum	$\frac{4}{17}$ Liberat.	÷	÷ $\frac{9}{17}$	$\frac{4}{17}$ $\frac{4}{17}$ $\frac{9}{17}$ $\frac{10}{17}$
18 83	♂	25	Hern. incarc.	♂	$\frac{17}{11}$ Herniotomy. pr. lap.	÷	÷	$\frac{17}{11}$ $\frac{17}{11}$ $\frac{21}{11}$
19 26	♂	13	Strang.	High ileum	$\frac{17}{11}$ Resect. intest.	÷	÷	$\frac{17}{11}$ $\frac{17}{11}$ $\frac{21}{11}$
20 64	♂	48	♂	Low ileum	$\frac{17}{9}$ Heostomy	÷	÷	$\frac{17}{9}$ $\frac{21}{9}$
21 62	♂	48	Volvulus ileo-coecalis	♂	$\frac{2}{15}$ Detorsio	÷	÷ $\frac{2}{15}$	$\frac{21}{15}$ $\frac{21}{15}$
22 55	♂	14	Adhaes. perit.	♂	$\frac{5}{11}$ Excisio intest.	÷	÷	$\frac{5}{11}$ $\frac{7}{11}$
Group								
23 76	♀	96	Adhaes. perit.	Low ileum	$\frac{17}{11}$ Liberat.	÷	÷	$\frac{17}{11}$ $\frac{21}{11}$
24 70	♂	96	Hern. incarc.	♂	$\frac{17}{11}$ Resect. ilei	Peritonitis	÷	$\frac{17}{11}$ $\frac{21}{11}$ $\frac{21}{11}$
25 40	♂	47	Strang.	♂	$\frac{17}{11}$ Resect. ilei	Peritonitis	÷	$\frac{17}{11}$ $\frac{21}{11}$
26 73	♀	144	Hern. incarc.	♂	$\frac{21}{11}$ Resect. ilei Heostomia	Peritonitis	÷ $\frac{2}{11}$	$\frac{21}{11}$ $\frac{21}{11}$
27 79	♂	♂	♂	♂	$\frac{17}{9}$ Heostomia	÷	÷	$\frac{17}{9}$ $\frac{17}{9}$
28 46	♂	96	Carcinoma	♂	$\frac{17}{11}$ Ileo-coecostomia. Heostomia	÷	÷	$\frac{17}{11}$ $\frac{21}{11}$
29 84	♂	72	Hern. incarc.	♂	$\frac{17}{11}$ Excisio intest.	÷	÷	$\frac{17}{11}$ $\frac{17}{11}$ $\frac{21}{11}$
30 45	♂	96	♂	♂	$\frac{2}{11}$ Heostomia $\frac{17}{11}$ Enterostast.	÷	÷	$\frac{2}{11}$ $\frac{2}{11}$ $\frac{17}{11}$

establish indices for the preoperative and, in part, postoperative treatment of these patients. This is of practical importance, particularly in the preoperative phase, in which one cannot wait for the results of certain hematological tests, such as fractional

Tot. Prot.%	Alb.%	Glob.%	Nonprot. Nitrog. Mg.%	Hgb.%	Red blood cells	Hemato- crit	Clorid M.eq.	Alcal reserv
7.74	4.66	3.08	50	105	5.32	40	89	52
6.69	4.23	2.46	49	100	5.1	38	92	53
5.81	3.90	1.01	37	94	4.61	34	107	57
5.99	3.49	5.50	36	81	4.00	33	112	58
6.58	3.92	2.66	67	107	5.30	48	91	57
5.27	3.12	2.15	60	87	4.8	32	98	60
4.97	2.97	2.00	29	96	4.8	31	100	58
6.08	3.88	2.20	36	104	6.1	41	103	52
4.69	3.09	1.60	32	90	5.95	38	108	56
6.62	3.15	3.47	34	100	4.75	38	96	57
6.32	3.91	2.41	40	102	5.13	41	94	58
6.28	3.17	3.11	31	93	4.08	38	98	60
6.47	3.55	2.92	25	75	3.09	31	85	54
6.01	3.21	2.80	34	74	3.8	30	90	52
7.94	5.19	2.75	20	118	5.5	50	96	64
6.46	4.20	2.26	29	105	4.97	45	104	60

## III.

5.84	3.48	2.36	55	98	4.6	39	94	63
5.23	3.23	2.00	45	74	4.1	30	87	53
5.71	2.98	2.73	60	94	4.7	37	95	64
5.54	2.99	2.55	65	92	4.8	41	100	58
5.23	2.88	2.35	38	95	5.0	44	88	57
6.70	3.90	2.80	40	102	5.24	39	99	65
5.88	3.32	2.56	55	94	4.9	40	90	67
6.11	3.20	2.91	30	94	4.6	40	95	58
5.79	3.00	2.79	40	86	4.4	37	90	54
7.11	4.00	3.11	65	116	5.6	45	103	58
7.04	3.84	3.20	90	110	5.7	49	111	59
6.28	3.97	2.31	35	101	5.13	43	95	64
5.79	3.76	2.03	44	95	5.00	40	93	68
6.39	3.29	3.0	42	114	5.4	48	105	58
6.92	3.12	3.10	40	98	5.0	45	106	58
5.97	3.25	2.73	35	998	4.6	40	100	60
7.79	4.44	3.35	56	116	5.9	44	83	58
6.15	3.85	72.30	40	91	4.51	30	95	52
7.40	3.95	3.45	35	100	5.00	41	88	58

protein determinations before starting treatment. The number of patients examined in this study in each group is small. Furthermore there is no definite borderline between the various groups. External factors such as age may also contribute to the difference

in the hematologic findings. However, the hematologic results in the groups as they have been set up are sufficiently uniform to justify the division made.

In group I the therapeutic problems are simple. As a rule these patients need so moderate additions of fluids and chlorides that they may be administered in conjunction with operative procedure, thus avoiding the loss of time involved in a lengthy pre-operative treatment.

In Group II there were uniform signs of hemoconcentration which appeared to reach maximum between 24 and 48 hours. In some cases there was a reduction in the serum proteins. This was most marked in those patients (12, 14, 19) whose strangulations were in the upper part of the small intestine. The actual hypoproteinemia was certainly greater than was evident from the nominal protein values, when the reduction of plasma volume was taken into consideration. This reduction has been shown experimentally in intestinal obstruction animals (AIRD, GENDER and FINE), and also exists clinically in cases in which obstruction has been of some duration (FINE, HURWITZ and MARK). Diuresis was low and there were signs of dehydration in some cases. Chloride values and alkaline reserve varied, but as a rule they were somewhat lowered. The general picture of these patients indicated that they were in a state of beginning shock and should be treated accordingly. Administration of water and saline without laboratory determinations of plasma proteins may have an untoward effect on these patients because the reduced osmotic pressure and increased capillary permeability cause a marked tendency to edema (17, 21). Therefore the primary object in the hydration treatment is to reestablish the osmotic pressure by means of plasma transfusions, and if these do not provide sufficient additions of fluid, they should be supplemented with physiological saline solution. Blood transfusion is indicated when there is an anemia resulting from hemorrhagic exudation in the bowel and peritoneum, as is seen in the most extreme types of torsion with marked circulatory disturbance.

In Group III, in which there were frequently marked signs of shock this treatment is the most important in that the first problem is to replace the plasma loss. An abnormal distribution of fluids in the various parts of the body may be seen as a symptom of increased capillary permeability. Thus it is not uncommon to see signs of dehydration in the face and upper parts of the body with

marked wrinkling of the skin and dry tongue, while there is simultaneously edema of the lower extremities. If the condition does not lead to diffuse peritonitis, large transfusions of plasma in the pre- and postoperative periods may have a life-saving effect. As a rule the preoperative treatment is limited in these cases because there is often gangrenous bowel wall. It is therefore impossible to reestablish the reserves of easily mobilizeable proteins preoperatively. Any major operative procedure performed on such a patient thus leads to a marked reduction in the serum proteins, and careful postoperative hematological control is necessary. This is particularly applicable in cases in which ileostomy has been performed, as there is then an accessory protein, salt and fluid loss. Patients with signs of peritoneal reaction are also included here.

The hypochloremia demonstrated in these patients was moderate and did not seem to predispose to complications in the postoperative course. It is possible that a slight hypochloremia may be advantageous to these patients who have such a marked tendency to edema. The organism can reduce its chloride loss in hypochloremia conditions by practically ceasing to excrete chlorides in the urine. A surgical patient who does not have abnormal loss of chlorides will have normal chloride and sodium levels over a long period in spite of a sharply reduced supply. Animal experiments (TAYLOR) demonstrate that marked reduction of blood chlorides of long duration does not have a toxic effect. As a whole it appears that the organism has less ability to regulate and tolerate losses of fluid and nitrogen than losses of chlorides, and that a moderate imbalance of chlorides is a factor of lesser importance in the acute intestinal obstruction syndrome.

There is no agreement as to the reasons for dehydration in conditions of acute intestinal obstruction. Generally speaking it is the result of the combination of reduced intake and increased loss. In addition some patients in shock show an abnormal distribution of body fluids which appears as a dehydration of the upper parts of the body and is caused by marked disturbance in capillary permeability. The predisposing factors for this dehydration are infection, high site of the strangulation, advanced age and malnutrition of long duration, as well as other conditions accompanied by chronic hypoproteinemia.

The demonstrated hypoproteinemia has in this condition, as in most other surgical diseases of the digestive tract, a complex pathogenesis in which reduced supply, increased loss and reduced

function of protein producing organs are important factors. Reduced protein production appears particularly in patients in Group III, as may be seen in the long period necessary for the regeneration of serum proteins after the obstruction has been relieved.

Both experimental and clinical investigators have noted that the reduced plasma volume and dehydration are related to the degree of distention in the affected bowel.

The roentgenologic and operative findings of the patients in this study did not show such a relationship. On the other hand the time factor, the duration of the incarceration, was the dominating factor. There are however, but very seldom, cases of acute obstruction which after a few hours show distinct shock symptoms, as shown in the table below.

Male, 41 years old, admitted 8 hours after outset. He had clinical symptom of peritonitic shock. 370 cm gangrenous and hemorrhagic intestine was resected. The hematological findings were as follows:

Date.	Tot. Prot. %	Alb. %	Glob. %	N. P. N.	Hgb. %	Red. blood cells	Hem. crit.	Chlorid. M. eq.	Ale. Res.
20/1 .....	5.72	3.62	2.10	60	82	3.88	34	100	62
21/1 .....	5.91	3.41	2.50	56	70	3.52	27	118	56

Between these hematological examinations he got 500 cc blood and 1,500 cc plasma.

In these cases the strangulation is so serious that the venous blood flow from the intestine is completely cut off. They present similar symptoms as an acute central mesenteric circulatory disturbance and diverge both clinically and hematologically from the cases in group I. The symptoms are based on a combination of peritonitic shock and hemorrhage.

### Summary.

The 30 patients with acute obstruction of the small bowel examined in this study can be divided into 3 groups according to the duration of the symptoms as follows: 3—12 hours, 13—72 hours and over 72 hours. The first group shows no marked pathologic changes in the hematological findings, the second demonstrates signs of dehydration and not seldom reduced serum protein values. The third group shows signs of shock. Therapeutic conclusions are



self evident. The causes of the dehydration and the hypoproteinemia are reduced supply combined with increased loss of fluids and proteins, and in the case of the serum proteins reduced production as well. The predisposing factors are advanced age, preceding malnutrition, infection and strangulation situated high in the bowel. The chlorides in the blood show some variations, but as a rule in cases of more than 12 hours duration they are reduced. Moderate hypocholesterolemia does not appear to have a specific pathologic effect in condition of acute intestinal obstruction and is therefore a minor therapeutic problem as long as there is no overdosage of chlorides.

### Zusammenfassung.

30 Ileuspatienten sind hämatologisch untersucht worden. Nach der Dauer der Krankheit können sie in drei Gruppen eingeteilt werden: 3—12 Stunden, 13—72 Stunden, und mehr als 72 Stunden. Der hämatologische Status der ersten Gruppe ist beinahe normal. In der zweiten Gruppe findet man Hämokonzentration oft mit Hypoproteinämie kombiniert. Die dritte Gruppe zeigt die gewöhnlichen Shocksymptome. Die therapeutischen Schlussfolgerungen sind daher klar. Die Ursachen der Hämokonzentration und Hypoproteinämie sind eingeschränkte Zufuhr und gesteigerter Verlust von Wasser und Proteinen. In der Genese der Hypoproteinämie spielt ausserdem herabgesetzte Produktion der Serumproteinen eine wichtige Rolle. Die Chloriden im Blut variieren einigermaßen. Bei längerer Krankheitsdauer als 12 Stunden sind sie in der Regel herabgesetzt. Eine moderate Hypochlorämie scheint nicht spezielle schädliche Wirkungen im Krankheitsbild zu haben. Die ist daher ein therapeutisches Problem von sekundärem Werte so lange nicht eine Überdosierung der Chloriden vorliegt.

### Résumé.

30 malades souffrant d'obstruction aiguë de l'intestin grêle sont examinés. Selon la durée de la maladie les cas sont divisés en 3 groupes: 1: 3—12 heures, 3: 13—72 heures, 3: plus de 72 heures. Dans le premier groupe on ne trouve pas des variations remarquables pathologiques dans le status hématologique. Dans le second groupe on trouve signes de déshydratation et assez souvent de hypoprotéinémie, dans le troisième groupe signes de choc. Les

conclusions thérapeutiques sont évidentes. La cause de la déshydratation et de l'hypoprotéinémie est la même: L'approvisionnement diminué combiné d'une perte augmentée des fluides et des protéines. Concernant la pathogénie de l'hypoprotéinémie s'ajoute comme facteur supplémentaire une production des protéines diminuée. Facteurs prédisposantes sont: l'âge avancé, dénutrition précédente, infection et strangulation situées dans la première partie de l'intestin grêle. La concentration des chlorures du sang varie peu, ordinairement elle est diminuée. L'hypochlorémie d'un degré modéré n'a aucun effet spécifique pathologique au syndrome de l'obstruction intestinale et constitue un problème thérapeutique d'importance secondaire.

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## Local Penicillin Treatment of Suppurative Infection in the Tendon Sheath.

By

ERIK UNONIUS, med. dr.

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At the County Hospital of Lappland, Rovaniemi, during the first half of the year 1936, I had the opportunity to test a new method in the treatment of suppurative infection in the tendon sheath. The method gave quite good results. Therefore I will give an account of the cases treated, though there were 8 only.

Longitudinal incisions with or without drainage have been suggested and tried. KLAPP made lateral incisions and to avoid necrosis of the tendon he considered it of great importance, that the tendon was not unprotected in the operation wound. HESSE emphasized the importance not to injure vessels or nerves. KANA-VEL found that drainage was most important. He made a long lateral incision, but left the tendon sheath closed at the joints. BROFELDT made two volar incisions, a distal one over the middle phalange and a proximal one from the middle of the proximal phalange to the end of the tendon sheath in the palm. VIDFELT opened the tendon sheath by a long volar incision and put irrigation rubber drains into the sheath, whereupon he closed the wound with just a few sutures. — GRETTVE has published very good results from the Sundsvall Hospital. He used an operation method suggested by HOLM. GRETTVE makes incisions across the finger, distally from the joints and opens the whole tendon sheath subcutaneously with a special knife. For the three middle fingers he makes small incisions also across the palm and for the two other fingers small longitudinal incisions. The results were, according to KEPPLER, recorded as *good*, *satisfactory* and *bad* ones. Under *good* results, complete restitution or normal functional effect is obtained. At the flexion the tip of the finger

touches the palm. The flexion in the metacarpophalangeal joint is normal and on extension only a slight defect in the erection of the finger tip may be allowed. Under a *satisfactory* result, a finger with a good working capacity is obtained. At flexion the tip of the finger should not be farther than 5 cm from the palm, and on extension the defect should not exceed 1 cm. Under the *bad*, the result is a disabled finger. — GRETTE recorded good results with HOLM's operation method in 42.8 % of the cases, 21.4 % being satisfactory and 25.8 % bad ones.

All above mentioned methods involve long incisions or several incisions, which, after healing, often cause functional limitations. GRETTE's method does, however, seem superior.

Having got penicillin, I decided to try a treatment, with hope of being able to combine a small operation with quick healing. Infections in covered cavities (pleura, joints) are, as is well known, successfully treated locally with penicillin if the infection is limited to the cavity. An advantage with local treatment, as compared with parenteral treatment, is that considerably smaller quantities of penicillin are necessary.

### Method of treatment.

The method of treatment was the following. The tendon sheath was opened through a small incision across the volar side of the finger close to a joint on the distal side as GRETTE has proposed. The incision was curved with the convexity distally, not too deep at the side, in order to save vessels and nerves. No more incisions were made. In the case of a part of the tendon sheath being especially tender when touched, or if pus somewhere under the skin was supposed, the incision was made at this point. The tendon sheath was then opened by a little cross cut. Thereupon a thin urethry catheter was put into the sheath in proximal as well as in distal direction. When the incision was made at the end of the tendon sheath only one catheter was used. The catheters were fixed to the skin with silk and then the tendon sheath was rinsed with a physiological NaCl-solution until clear fluid. Then 0.2—0.6 ml penicillin solution, containing 5,000 units per ml were injected. The operation was affected without bleeding and in general anaesthesia. After that, rinsing and injection of penicillin solution every 4th—6th hour were continued, until the rinsing fluid became clear and did not contain bacterias on direct exa-

mination. Only for a few days the finger was immobilized by bandage, after which hand baths, and active movement therapy were applied.

It often proved difficult to put the catheter in the proximal direction, if the incision lay distally from the first interphalangeal joint, and it was almost impossible, if it lay distally from the last joint. — The uretery catheters are obviously not meant for this purpose and were in 4—5 days covered with hard crusts, evidently irritating the tendon.

### Results.

The patients treated were 6 men between the ages of 20—38 years, and two women, 20 and 42 years old. In all the cases except one, the infection was caused by accident. The patients received treatment 2—4 days (in one case 4 hours, in another 6 days) after the symptoms appeared. The infection kept in the tendon sheath, or in this and the injured place. In all the cases only one finger was affected. The prognosis has thus been rather favourable. The amounts of penicillin used were small, between 20,000 and 200,000 units only.

The results are shown in the following table. I have grouped the results according to KEPPLER.

*Table showing results when treating suppurative infection in the tendon sheath with penicillin injected through a catheter into the sheath.*

Case No.	Sex Age	Elapse of time be- tween be- ginning of the disease and opera- tion	Finger	Total amount of pe- nicillin	Days of treat- ment	Bacterias	Result
1. 164/46	♀ 20	2 days	Thumb	134,000	10	Gram-diploc.	Good
2. 301/46	♂ 35	4 »	II	67,500	9	Gr. + cocc. in chains	Satis- factory
3. 422/46	♂ 20	3 »	II	192,000	7	Not examined	Good
4. 533/46	♂ 22	6 »	Thumb	20,000	5	Gr. + cocc. in groups	Good
5. 595/46	♂ 38	2 »	II	98,500	16	»	Satis- factory
6. 831/46	♂ 23	2 »	II	78,000	14	»	Bad.
7. 1003/46	♀ 42	4 hours	II	40,000	6	Gr. + cocc. in chains	Good
8. 1323/46	♂ 30	4 days	II	56,000	8	Gr. + cocc. in groups	Good

In five cases out of eight the results were good, in two cases satisfactory, in one case bad. I believe that the reason for the results not being better may be due to the irritation of the tendon and the tendon sheath caused by the catheter, when covered with crusts. In case No 6 the catheter remained in the sheath 14 days, and when removed it was covered with crusts, nearly a millimeter high. This was the bad case. Case No 5 was treated for a still longer time (16 days), but a change of catheter was made once (on the 6th day). In case No 3 the same catheter remained for 9 days. In both these cases the result was not good. Case No 8 was treated for 8 days, but the catheter was changed once (on the 4th day). In case No 1, on the other hand, the same catheter remained for 10 days, and on removal showed no crusts at all. Either a catheter of another manufacture was used, or the patient did not react in the same way as the others. — The results from these two cases were good. In the cases No 3, 4 and 7 the catheter was kept for 7, 5 and 6 days respectively, the results being good.

The treatment caused no pain. The patients were able to move the finger with the catheter in place without feeling pain. — It is advisable not to introduce the catheter proximally so far that in flexion it touches the end of the tendon sheath, as this would cause pain and prevent the patient from moving the finger. Besides there would be a risk for perforating the sheath.

In none of the cases was the operation followed by sensibility disturbances. The operation scars were hardly visible and gave no trouble.

I believe it would be worth while to give the method further trial and I think better results could be attained with drains that do not irritate the tissues.

### Casuistry.

*Case 1. 104/1946. A girl, aged 20. — Trauma not known. —* <sup>19</sup>/<sub>1</sub>: reddening and pain along the whole flexor tendon of the right thumb. — Admitted <sup>21</sup>/<sub>1</sub>. General condition good. Virgo. No sign of vaginal infection. No trace of gonococci in cervical or urethral secrete. SR 38 mm. Local: Reddening, swelling and pain when touching along the volar side of the right thumb and wrist. *Canalisatio vaginae tendinis*: The tendon sheath was opened above the ligam. carpi, and contained an abundancy of thin matter, showing by direct examination Gram-diplococces, very like gonococces. A fine uretery catheter was introduced into the tendon sheath that was rinsed with a physiologic

NaCl-solution, after which 2,000 units of penicillin were injected through the catheter. —  $^{23}/_1$ — $^{30}/_1$ : rinsing, and injection of 2,000 units of penicillin every 6th hour. When removed, the catheter was clean. —  $^{23}/_1$ ,  $^{24}/_1$ ,  $^{28}/_1$  and  $^{29}/_4$ : sulfatiazol, 6 grammes in all. —  $^{25}/_4$ : hand bath and mobilization. — Temperature on  $^{23}/_1$ :  $38^{\circ}$  C, then subfebrile until  $^{28}/_1$ , after this date normal. — Left hospital  $^{31}/_1$ . — Upon inquiry on  $^{1}/_6$  found normal mobility and working capacity of the finger.

*Case 2. 301/1946. A carpenter, aged 35.* —  $^{4}/_2$  he cut himself with an axe a superficial wound across the right palm. The wound was not sutured. He remained at work. —  $^{11}/_2$ : he hurt his hand while working. On the following day pain started. — Admitted  $^{15}/_2$ . General condition good. SR 36 mm. On the ulnar side of the right palm an almost healed cut wound, about 5 cm long. The palm, distally from the wound, and the basal part of the middle finger swollen. Slight swelling also on the back of the hand. Pain when touched along the flexor tendon of the second finger. *Canalisatio vaginae tendinis*: A small incision across the finger distally from the first interphalangeal joint. Matter in the tendon sheath, containing Gram + cocces in chains by direct examination. Rinsing, and injection of 2,500 units of penicillin. —  $^{16}/_2$ — $^{23}/_2$ : 1,500—2,500 units of penicillin every 6th hour. The catheter, when removed, was covered with crusts. — Because of slight pain in the palm on  $^{19}/_2$  he got 10,000 units of penicillin every 4th hour during 3 days. —  $^{21}/_2$ : hand bath and mobilization. — Slight rise in temperature until  $^{23}/_2$ , then normal. Left hospital  $^{25}/_2$ . — Final status  $^{9}/_5$ : The finger was somewhat thickened at the base. At flexion the tip of the finger reached 4 cm from the palm. Movement in the metacarpophalangeal joint normal. The first interphalangeal joint movable between the  $30^{\text{th}}$  and  $60^{\text{th}}$  measured from extended position, and the last joint between  $10^{\text{th}}$  and  $20^{\text{th}}$ . The strength of the muscles good. At work since  $^{7}/_5$ .

*Case 3. 422/1946. Chauffeur, aged 20.* —  $^{1}/_3$  he pricked his right middle finger with a wire. Next day pain and swelling on the volar side of the finger. On the third day swelling also on the dorsal side of the hand. — Admitted  $^{4}/_3$ . General condition good. SR 68 mm. Strong swelling and pain when touching on the volar side of the right second finger and the palm. Strong swelling on the dorsal side of the hand. *Canalisatio vaginae tendinis*: A small incision across the finger distally from the first interphalangeal joint. Much thin matter in the tendon sheath. Bacteria examination was not made. A thin uretery catheter in both distal and proximal direction. Rinsing, and injection of 3,000 units of penicillin in both directions. —  $^{5}/_3$ — $^{9}/_3$ : 3,000 units of penicillin in both directions every 6th hour. When removed, the catheter was discoloured. —  $^{7}/_3$ : hand bath. — Left the hospital  $^{10}/_3$ . — Informed on inquiry on  $^{1}/_4$ , that the finger was of quite normal strength and mobility.

*Case 4. 533/1946. Workman, aged 22.* —  $^{15}/_3$  he got a nail in his right thumb. 2 days later pain and swelling, also lymphangitis up to



the axillar glands. — Admitted  $21/3$ . General condition good. SR 29 mm. The right thumb badly swollen. Pain on touching along the flexor tendon. Obvious lymphangitis from wrist to elbow. Very painful enlarged axillar glands. *Canalisatio vaginae tendinis*: A small incision across the finger distally from the last joint. Matter in the tendon sheath, containing Gram+ coccus in groups by direct examination. A thin ureteric catheter in the sheath up to the wrist. Rinsing, and injection of 1,000 units of penicillin. —  $22/3$ — $25/3$ : 1,000 units of penicillin every 6th hour. —  $26/3$ : examination of bacterias from wound; bact. —. leucoc. ++. When removed, the catheter was discoloured but not incrustated. — Only on  $23/3$  in the evening a slight rise in temperature to  $37.7^{\circ}$  C. — Left hospital  $27/3$ . Working since  $6/4$ . — Final status  $30/4$ : Almost invisible, slightly adherent scar. Slight weakness in extension of the last joint. At flexion + opposition the tip of the finger reached the base of the little finger. Muscle strength good. No impediment when working.

*Case 5. 595/1946. Mason, aged 38.* —  $16/3$  he got a nail in middle phalange of the left second finger. —  $20/3$  the finger began to ache. — Admitted  $23/3$ . General condition good. On the volar side of the middle phalange of the left middle finger a small, infected wound. Reddening, and pain when touching along the volar side of the finger. Finger and palm swollen. *Canalisatio vaginae tendinis*: Incision across the finger on the wound. Tendon sheath open, containing a lot of matter. By direct examination Gram+ coccus in groups. A thin ureteric catheter into the tendon sheath in proximal direction. Rinsing, and injection of 1,500 units of penicillin. —  $24/3$ — $27/3$ : 1,500 units of penicillin every 6th hour. —  $2/4$ : hand bath. — When removed, the catheter was covered with crusts. —  $10/4$ : examination of bacterias from wound: negative. — Temperature on  $31/3$ :  $38.5^{\circ}$  C, subfebrile until  $4/4$ , then normal. — Final status  $2/7$ : The finger normally movable together with the other fingers, and does not interfere with the work. At flexion of the injured finger alone, the tip reached  $1\frac{1}{2}$  cm from the palm.

*Case 6. 831/1946. Workman, aged 23.* —  $7/5$  he pricked the volar side of the left second finger with a knife. The same day the finger began to ache. — Admitted  $9/5$ . General condition good. SR 24 mm. On the volar side of the middle phalange of the left middle finger an infected cut wound, 1 cm long. The finger was very swollen. Pain when touching along the flexor tendon. Also slight pain at the base of the first and third finger. The back side of the hand swollen and reddening up to the wrist. *Canalisatio vaginae tendinis*: Incision across the finger distally from the last joint. Thick matter. By direct examination Gram+ coccus in groups. Failure to introduce the catheter into the tendon sheath necessitated a new incision at the place of the wound, whereupon the catheter was introduced. Rinsing, and injection of 3,000 units of penicillin. Immobilization. —  $10/5$ — $22/5$ : 3,000 units of penicillin every 6th hour. — Examination of bacterias from wound  $18/5$ ,  $20/5$ ,  $21/5$  and  $22/5$ : negative. —  $22/5$  SR 7 mm. — Sulfatiazol in the first 5 days. — By mistake the catheter was allowed to remain for too long a time, and

when removed, it was covered with crusts in abundance. — Temperature  $^{10}/_5$ :  $39.1^{\circ}$  C, rise in temperature until  $^{13}/_5$ , then normal. — Status  $^{26}/_6$ : The finger interfered with his work. The last joint stiff, the middle joint movable between  $20^{\circ}$  and  $25^{\circ}$  measured from extended position, basal joint between  $0^{\circ}$  and  $80^{\circ}$  from extended position. *Amputatio*: Amputation, at the patient's request, almost distally from the first interphalangeal joint. — Stump healed  $^3/_7$ .

*Case 7. 1003/1946. Peasant's wife*, aged 42. —  $^7/_6$  she got a wood splinter in the right second finger. The splinter was immediately pulled out. An hour later severe pain in the finger. Admitted 4 hours after the accident. General condition good. SR 17 mm. The right middle finger slightly swollen. Pain when touching along the flexor tendon. Reddening along the dorsal side of the finger. *Canalisatio vaginae tendinis*: A small incision across the finger distally from the basal joint. Thin matter in the tendon sheath. By direct examination Gram+ cocci in chains. A thin urethry catheter was put both distally and proximally. Rinsing, and injection of 2,000 units of penicillin in both directions. —  $^8/_6$ — $^{12}/_6$ : 2,000 units of penicillin in both directions every 6th hour. — Slight rise in temperature until  $^{10}/_6$ , then normal. —  $^{10}/_6$ : hand bath and mobilization. — When removed, the catheter was discoloured but without crusts. — Left hospital  $^{12}/_6$ . Status: No swelling. Slight stiffness in the last joint. At flexion the finger reached  $1\frac{1}{2}$  cm from the palm. — She was not examined later, but the result being already so good at the end of only five days treatment, complete restitution might be presumed (Compare with case 8).

*Case 8. 1323/1936. Mason*, aged 30. — Rubbing against working tools caused  $^1/_8$  a blister on the volar side of the right middle finger. The blister became infected. —  $^4/_8$ ; pain in the finger and swelling along the volar side. — Admitted  $^7/_8$ . — General condition good. SR 32 mm. The right second finger badly swollen. Pain when touching along the flexor tendon. At the basal phalange fluctuation was ascertained. The finger was kept in middle position and could not be moved. *Canalisatio vaginae tendinis*: A small incision across the finger distally from the first interphalangeal joint. Thick matter. By direct examination Gram+ cocci in groups. A catheter was put in both proximal as distal direction. After rinsing 1,000 units of penicillin in both catheters. — The whole time no rise in temperature. —  $^{10}/_8$ : examination of bacterias: negative. Catheter exchange. The removed catheter was discoloured but not incrustated. —  $^{13}/_8$ : examination of bacterias: negative. Catheter removed; discoloured but not incrustated. —  $^{14}/_8$ : hand bath and mobilization. — Left hospital  $^{16}/_8$ : SR 7 mm. At flexion the finger reached 3 cm from the palm. — Final status  $^{12}/_8$ : slight extension defect of the tip of the finger, which at flexion reached the palm. An almost invisible scar. Good working capacity.

## Summary.

Eight patients with suppurative infection in the tendon sheath two in the thumb and six in the middle finger, were treated with penicillin through an ureteric catheter inserted into the tendon sheath. A small transverse incision was made distally to one of the finger joints without injuring vessels or nerves. Dependent on the place of incision, a thin ureteric catheter was introduced in proximal direction or in proximal as well as in distal direction. More incisions were not made. Rinsing with a physiologic NaCl-solution and injection of 1,000—3,000 units of penicillin every 6th hour during 5—16 days (total dosage 20,000—200,000 units). Mobilization at an early stage. Issues: 5 good, 2 satisfactory and one bad.

## Zusammenfassung.

Bei 8 Patienten mit eitriger Tendovaginitis waren 2 im Daumen und 6 im Mittelfinger lokalisiert. Behandlung mit Penicillin, welches durch einen Ureterkatheter in die Sehnenscheide eingeführt wurde. Der Katheter wurde durch einen kleinen Querschnitt distal eines Fingergelenks eingeführt ohne Verletzung von Gefässen und Nerven. Weitere Incisionen wurden vermieden. Je nachdem wo der Schnitt gemacht werden musste wurde der Katheter distal- und proximalwärts oder nur proximalwärts vorgeführt. Jede 6. Stunde Spülung mit physiologischer NaCl-lösung und Injektion von 1,000—3,000 E. Penicillin. Totaldosierung in 5—16 Tagen 20,000—200,000 E. Mobilisation so bald wie möglich. Resultate: 5 gute, 2 befriedigende, eines schlecht.

## Résumé.

Chez 8 malades atteints de tendovaginite suppurée l'infection était localisée 2 fois au pouce et 6 fois au médius. Traitement par la Pénicilline qu'on injecta dans la gaine synoviale au moyen d'une sonde urétérale. Cette sonde était introduite par une petite incision transversale, en aval d'une jointure digitale, en ménageant vaisseaux et nerfs. On s'abstint d'autres incisions. Selon le niveau où il fallait faire l'incision, on poussait la sonde en aval et en amont, ou seulement en amont. Toutes les 6 heures, irrigation

avec de la solution salée physiologique, suivie d'une injection de 1,000 à 3,000 U. de Pénicilline. Dose totale en 5 à 16 jours: 20,000 à 200,000 U. Mobilisation aussi précoce que possible. Résultats: 5 bons, 2 satisfaisants, 1 mauvais.

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## Two Cases of Incarceration in a Defect in the Mesentery of the Small Intestine.

By

EINO E. VUORI.

Loimaa.

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The mesentery of various parts of the intestine of man is in exceptional cases the site of apertures in which a coil of intestine, when passing through, may become more or less complicatedly incarcerated. Such extremely rare occlusions have been described as occurring in the mesocolon (in 1731 by BRAMBILLA), in the mesosigmoid, mesorectum, and even in the mesenterium, most cases being observed, however, in the mesentery of the small intestine. A first solitary instance of the last-mentioned kind was published by HEUERMANN in 1778, and the first resumé of cases so far reported in the literature was written by BESNIER as early as in 1860. It included eight cases, but according to PRUTZ's list there should have been nine. In 1907 PRUTZ had collected 41 such cases, by 1920 the number of published cases had risen to 53 (FEDERSCHMIDT) and by 1936, according to PAPOUSCHEK, 80 cases should have been stated. Later than FEDERSCHMIDT's report I have, myself, counted 43 cases. A list of these cases is given in connection with the references. These cases are proportionally most frequent in the "occlusion areas of eastern Europe" and in northern America. Several cases have also been published from Scandinavia; from Finland there is, however, only one case (STRÖMBORG). All ages are represented among the patients, starting with newborn infants to old people, the majority of course being children and adolescents. The male sex predominates.

In Kuopio County Hospital the following two cases occurred last summer. I am greatly indebted to the Chief of the hospital, Professor MARTTI HÄNÄLÄINEN, for the use of these.

*Case 1.* Journal 3393. Aug. 10th, 1946. Diagnosis: Volvulus intestini ilei per foramen congenitale mesenterii. S. L. Aged 24, workman from Leppävirta. In 1941—42 twice admitted to a military hospital because of dyspepsia. It was then established that the patient suffered

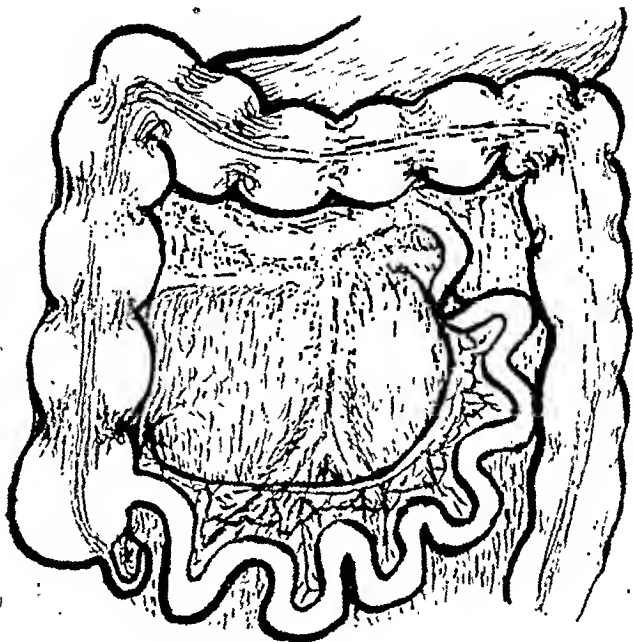


Fig. 1. Case 1. Schematic picture of the situs intestinorum after the loosening of the torsion.

from hyperacidity. No pathologic changes appeared in the roentgenograms. Last night the patient felt slight pains in the stomach. He slept, however, until he was awakened in the night by severe pains first in the umbilical region, and then gradually passing over to the right side of the abdomen. Neither gas nor evacuation of bowels since yesterday. Frequent vomiting, the vomitus had no feculent odor.

Present state: The patient is pale and perspires, severe shock condition. The pulse is small and frequent, the blood pressure only 60 mm Hg. Nothing notable in heart and lungs. The upper part of the abdomen is somewhat distended. The abdomen is tender throughout, and very tympanitic. The jecoral tone has disappeared. No succussion sounds, neither borborygmus. No peristaltic movements observed. First impression: perforated ulcer. Strophanthin-etyphyllin-glucose and plasma are given on account of the severe shock. However, as it does not pass within two hours (another patient was operated on in the meantime), preparations for an operation are made about 22 hours after the onset

of symptoms. Having inhaled a few breaths of ether the patient begins to vomit. The narcosis is interrupted, and the stomach emptied by means of a rubber tube. The patient then collapses and unconsciousness follows. The breathing changes into a Cheyne-Stokes respiration, and ceases gradually. In order to establish the cause of death post mortem examination is carried out on the operating table (VUORI).

The whole of the visible small intestine is somewhat distended and of a purple-black colour. It contains little air but is filled with a highly blood-mixed fluid. When the fluid is removed the occlusion is found to have arisen thus: almost the total small intestine has twice passed an aperture in its mesentery in a direction from below—backwards—upwards—forwards, causing right of Treitz's ligament and left of the ileocecal valvel such a tight torsion around the long axis of the intestine that the passage in it and in the venae of the mesentery becomes completely constricted. When the torsion — this is probably the most correct denomination — is loosened, there still remains, about 1 meter from Treitz's ligament, a torsion of  $180^\circ$  around the long axis of the intestine; it has arisen by the jejunum having adhered on the side opposite to the insertion of the mesentery, to the oral side of the peripheric edge of the aperture in the mesentery. Here a funnel-shaped diverticulum of about 2 cm has arisen in the wall of the intestine, evidently owing to tearing. In my opinion this adhesion could not have been the primary cause of the volvulus as in that case its course should have been in the opposite direction. Of the previously mentioned  $720^\circ$  torsion the most oral one was situated somewhat orally of this place, and so far the intestine was normal. When examining the aperture in the mesentery the latter proved to be, in its narrowest portion, an arch of only about 10 cm in breadth. Its upper end was attached to the posterior wall of the abdominal cavity near Treitz's ligamentum and its lower end near the ileocecal valvel along an area of a few centimeters. The intervenient border is quite smooth and free of sears, and here the extremely thick superior mesenteric artery and superior mesenteric vein have their course. There is no free posterior edge in this opening of about two handbreadths, but the parietal peritoneum here follows directly along the posterior wall of the abdominal cavity without forming duplications.

*Case 2.* Journal 2727. June 27th, 1946. Diagnosis: Incarceratio intestini ilei et coli sigmoidei in foramen congenitale mesenterii. E. R. Aged 15, shoemaker's son from Kiuruvesi. Last night the patient suffered from severe pain in the abdomen. In the morning he vomited for the first time. Neither gas nor bowels since yesterday.

Present state: The patient is in a very bad condition, pale, perspires. The pulse is small. Nothing notable in heart and lungs. The abdomen is greatly distended and in the umbilical region there is a separate knotlike prominence. Peristaltic movements are clearly noticed, also splashing. The patient is stimulated and given an infusion of physiological NaCl solution. About 20 hours after the onset of symptoms an operation is made in spite of the severe shock condition. Diagnosis: Occlusio intestini.

*Laparotomia. Detorsio et deliberatio. Enterostomia a. m. Witzel.* Ether anesthesia (RAIVIO). The abdomen was opened by an incision in the middle line, below the umbilicus. The first bows of the small intestine to be seen are black and atonic. When the cause of the occlusion is sought it appears that about 2.5 m of the ileum and about 60 cm of the sigmoid flexure have penetrated from the left below to the right upwards through an aperture of about 2 fingerbreadths with smooth edges, situated in the mesentery of the former near the ileocecal angle,

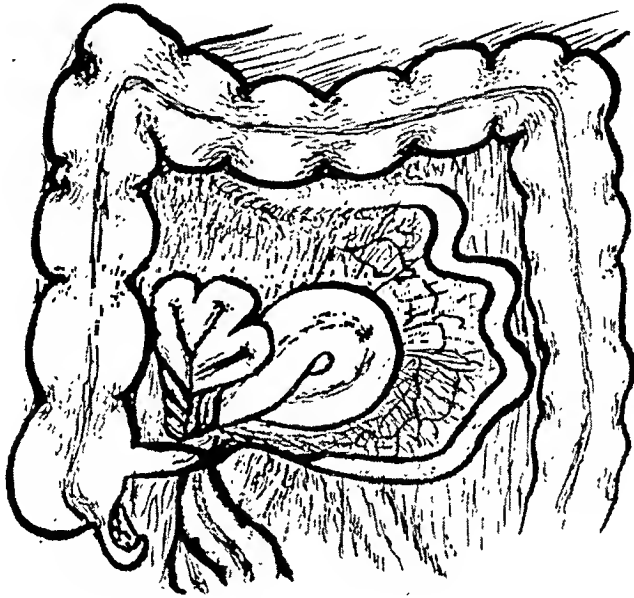


Fig. 2. Case 2. Schematic picture of the situs intestinorum fore the release of the intestines.

where they have incarcerated, both being separately twisted around their mesenteric axis. Enlarging of the opening allows the constricted intestine to be drawn back through it. The aperture is then closed with three silk sutures. As the condition of the patient is threatening a decision is made to end the operation by forming a Witzel's fistula. Exitus lethalis when the wound is being closed.

*Epicrisis:* In the former case there was a torsion of 720 degrees of almost the whole small intestine through a probably congenital aperture posterior to the about 10 cm wide arcade-shaped mesentery. In the latter case there was incarceration and volvulus of ileum bows and the sigmoid flexure into a probably congenital aperture of about two fingerbreadths in the mesentery of the small intestine near the ileocecal angle.

*Location, size and shape of the apertures.* Comparing my cases with those reported in the literature I find that there are none



similar to my first case regarding the size, location and character of the aperture, and the length of the incarcerated intestine, previously published. A case described by FEDERSCHMIDT is somewhat similar. In it the mesentery of the lower one third of the ileum also took the form of a wide arch of about 10 cm between the ends of which remained "a large gap, the shape of a somewhat extenuated horseshoe". Just that portion of the ileum which is attached to the free mesentery, had passed through the opening, then twisting still 360° clockwise. In the case of TÜRK the aperture was also situated in the radix (of the mesenterium ileo-coli commune!) but in its upper portion immediately below the duodeno-jejunal flexure, by a. and v. mesenterica sup., its size being about  $3 \times 2$  finger-breadths. Beside these two cases only a very few more have been published in which the aperture, being only about 1 finger-breadth in size, was situated in the radix quite close to the posterior wall of the abdomen. There are also a few cases in which the opening was situated in the middle of the mesentery belonging to the middle one third of the ileum. The great majority of the apertures were located similarly as in my second case, viz. near the ileocecal angle. Most of them were found in the periphery of the mesentery, sometimes even quite close to the intestine; the mesentery was missing in this place in the case of HOMMES even at a length of 20 cm. The size of the apertures was generally small, a few sq.cm only, but larger ones were also observed, i. e. three being the size of the palm of the hand (BLECHER, CHARBONNIER, HOHLBAUM). The most common form was round or oval, but also slitlike openings in a radial direction were described.

*The strangulated portion of intestine.* This was mostly a part of varying length of the small intestine near the aperture through which it sometimes carried along with it the mobile cecum and the appendix, in the case of TRENDLENBURG—v. OFENHEIM even a part of the ascending colon. Of course there was in this case mesenterium ileo-coli commune. Moreover it had passed the aperture twice, and this was the only case except my own in which this had happened. A more distantly situated loop of intestine was very seldom constricted, for instance, the transverse or the descending colon or the sigmoid flexure. Only STRÖMBORG (Finland), TALMANN and MUZENIEK have all described one case in which both the small intestine and the sigmoid flexure were simultaneously constricted, similarly as in my second case yet

with the difference that in their cases they had passed into the aperture from opposite sides of the mesentery. They were generally directed from the left below to the right upwards.

*The strangulation mechanism* may be described thus: following strain first only a very short portion of the intestine penetrates, or, if there is a large opening, slides accidentally into the aperture. Cases have been published in which symptoms set in during sleep. Owing to the intestine being strangulated, or, as in the second case, to a bend over the edge of the aperture or to the twisting of a loop, a disturbance of the passage and of the circulation of the blood occurs. The intestinal gases cannot pass, neither are they absorbed in the blood but their pressure causes an enlargement and distention of the loop in question, thus completing the occlusion and making the return of the loop impossible; the reverse occurs, in that more intestine is pulled through the opening. The peristalsis has a similar effect, as, according to PRUTZ, the intestine reacts to the surrounding edges of the aperture as to a foreign body, thus trying to force it, by means of peristaltic movements, in an anal direction. However, as the edges of the aperture are fixed in this case and the intestine is mobile, the result is that peristalsis presses more intestine through the aperture. Further, the peristalsis probably causes volvulae and torsions which complicate the incarceration. When there is a question of large openings these volvuli cause a sudden change to the worse of the condition when the strangulation becomes total after many days of less serious symptoms.

*The etiology* is not always homogeneous. In the epicrisis, I already mentioned congenital apertures, but postnatal apertures have also occurred even if they are very uncommon, as will be seen from the following.

Most of the older authors consider *trauma* the causal factor of apertures. There are, however, only a few cases which may be considered unmistakably traumatic. According to various writers the number of these cases is 12, at the most (there are, however, owing to imperfect records very uncertain cases in my opinion). These represent only about 12 per cent of all cases published. It is natural that trauma cannot play an important part in the etiology of mesenteric apertures, as isolated injuries to the mesentery are very rare.

*Openings occurring in connection with operations* may primarily be considered traumatic. They are, of course, rarely found in

the mesentery of the small intestine, and to my knowledge only one case of similar incarceration has been published. But, on the other hand, there are several cases of incarceration in post-operative apertures in the transverse mesocolon, generally following a posterior gastro-enterostomy; they are often caused by the carelessness of the surgeon (cf. BLECHER and HOHLBAUM's lists).

*Various inflammatory processes* may also cause the formation of apertures. LENNANDER, HOHLBAUM and PAPOUSCHEK have, independently, described one case in which an opening was formed following tuberculosis of the mesenteric glands. Appendicitis has also been considered of etiologic importance in this connection, but there is, in spite of the frequency of appendicitis, probably but one case published, viz. that of KING. This theory is vigorously denied by PAPOUSCHEK. He suggests, however, mesenteritis and arteriosclerosis as possible causes. In this connection I wish to stress the fact that mesenteritis is generally of a hypertrophic character. Ulcer of the stomach and of the duodenum may be the causative factor of an aperture in the transverse mesocolon only.

As postnatal apertures are rare, as appears from the paragraph above, *congenital* apertures predominate. There are various theories on the genesis during the fetal development. TREVES and others consider poor nutrition of the mesenteric area (= POIRIER's *aire mésentérique*), near the ileocecal angle with its few vessels to be the cause. TALMANN believes that a strong peristalsis or a trauma may cause a weak tissue of this kind to burst. HOHLBAUM in his control investigations established regularly such an area in fetus of 6 to 8 months, whereas PRUTZ and WALDEYER have not found any. The latter observed, however, more numerous pouch formations in fetal mesenteries than have been established in adults. HOHLBAUM assumes that they are partly responsible for the occurrence of apertures, and REINHARDT believes that at least apertures in the transverse mesocolon, where they are most frequent, occur when the bottom of the pouch bursts as a loop of intestine is pressed into it.

PRUTZ, PAPOUSCHEK and others consider the tension which arises in the mesentery caused by its disproportional growth and that of the intestine, when the cecum moves down to its final place. The tension is assumed to be greatest just at the ileocecal angle. HOHLBAUM and HOMMES have combined this theory and that of TREVES, and HOMMES has enlarged it further. Already

FEDERSCHMIDT stressed that only ileocecal apertures might be explained in this way but not those more to the center of the radix. FEDERSCHMIDT's and TÜRK's cases as well as the first one of mine can, in no circumstance, be elucidated by these theories. It should further be pointed out that in TRENDELENBURG—V. OFENHEIM's and TÜRK's cases of mesenterium ileo-coli commune no tension produced by the wandering of the cecum could have occurred and caused the formation of an aperture.

PRUTZ mentions the deficient secondary fixation of the mesentery during the development of the cecum and the colon, and refers to the four cases in the literature in which an aperture occurred in the radix as a support of his theory. He was joined by TÜRK who thought that he had thus found a simple explanation of the defect in the mesenterium ileo-coli commune of his patient (described on page 545). The anomaly of the mesentery has naturally arisen exactly in this way, but openings in the mesentery cannot be formed thus, as already pointed out by FEDERSCHMIDT. It might be supposed, of course, that together with the mesentery tangential pouches and canals could occur in this way. Thus, or rather, by a supernumerary fixation, PARSON's unique case might be explained; in it incarceration had taken place between the folds of the double mesosigmoid.

None of the above mentioned theories — except perhaps the pouch theory of REINHARDT — can explain the origin of apertures occurring in the transverse mesocolon, the mesosigmoid, the mesenteriolum and the ligamentum latum. LANDOIS, in his investigation, arrives at the conclusion, that there is no general etiologic elucidation.

FEDERSCHMIDT looked for an explication of this question in the phylogenesis. According to BROMAN's investigations apertures are regularly found in the dorsal mesentery of the lower vertebrata and even in that of birds. HUTYRA and MAREK, on the other hand, stated that out of 1,069 cases of occlusion, occurring during a limited period, in horses of the Prussian army, and leading to death, incarceration had in 218 cases taken place by way of openings in the mesentery. In the Veterinary Clinic of Berlin the corresponding proportion was 34/93, or exceeding this figure. On the basis thereof he also explains that the defects appearing as rare anomalies in the dorsal mesentery of man, are atavistic products of the same process of rarefaction which the ventral mesentery in our body is regularly subjected to. In this

way the apertures of other portions of the intestine may also be easily and analogously explained. On my part I feel inclined to accept this theory as it is the only one which can clarify my case nr. 1. As for the time of the formation of the aperture, it should, at least according to FEDERSCHMIDT, TÜRK, and in my first case mentioned above, have occurred before the intestine had turned which would explain the exceptional character of these cases.

As an evidence of the inherence of mesenteric apertures it should be mentioned that their bearers often have other indisputable congenital defects or anomalies. In addition to the previously mentioned cases of mesenterium ileo-coli commune, Meckel's diverticulum was, for instance, found in 7 patients, which is considerably more often than expected in relation to the incidence of the anomaly.

*The past history and the present state* cannot always be analogous; they have to vary in the individual cases, depending on what part or parts are involved and how great portions of the intestine have been constricted. They further depend on the size of the aperture in which the incarceration has taken place. When the aperture is small the occlusion is rapidly completed, whereas in the case of a large aperture it develops more slowly and less violently, exhibiting rather indefinite symptoms. In the latter case the patient may not come to the hospital until the elapse of several days of illness — when the pains have increased suddenly. There are instances described in literature when an operation has been made, even successfully, three weeks after the onset of the symptoms (GREIG SMITH). In those cases gangrene has naturally not developed, whereas constriction in small apertures rapidly leads thereto. The conditions are thus quite similar to those in extra-abdominal hernias which these intra-abdominal incarcerations misleadingly resemble. If the opening is large there must be some other occlusive factor, although it may appear later, which causes gangrene apart from the passing of a portion of intestine through the aperture; this may be, for instance, volvulus or a firm torsion. Because of the impeded circulation of venous blood large quantities of blood may flow into the intestine causing a severe shock. It should be observed, however, that also a tight strangulation sometimes causes shock, and nodus always does so. As the factors influencing the picture of the disease are so numerous there can be no homogeneous development, or any symptom or syndrome characteristic of an occlusion with this etiology.

Diagnosis is therefore limited to an establishment of an occlusion only, often of strangulation type. Volvulus ceci has sometimes been diagnosed in cases where a protuberance caused by loops of intestine incarcerated in an ileo-cecal mesenteric aperture, was perceptible to touch or even visible on the right side of the abdomen. Other incorrect diagnoses may be mentioned, for instance appendicitis, and peritonitis due to a perforative ulcer or appendicitis. A confusion with acute pancreatitis and mesenteric thrombosis is also possible. A correct diagnosis has so far never been made.

*Therapy.* This is naturally aimed at surgical liberation of the constricted intestine and a resection of necrotic portions. In a few cases there is a small possibility of spontaneous recovery as evidenced by the anamnestic attacks in some cases. A reposition does not always succeed without an incision of the edge of the aperture, which may involve some danger as large veins are lodged here. In order to avoid recurrence an effort should be made to close the opening; it is generally an easy task when the aperture is small or slit-like, and can be done by simply uniting the edges. For closing large openings transplantation of omentum or fascia can be performed, but this may also be very difficult and even impossible, particularly in my first case.

*The prognosis* depends, naturally, as in other cases of occlusion and extra-abdominal incarceration, completely on whether an operation can be made at an early stage. The duration of the journey to the hospital, inadequate communications and other secondary factors may thus be of decisive importance. According to my calculations the rate of mortality has so far been about 33 per cent (73 cases considered).

### Summary.

The investigation is based on two cases of occlusion. In the first case the mesentery of the small intestine was fixed to the posterior wall of the abdominal cavity with both ends only, near to the lig. Treitz and to the ileo-cecal valve. Between these points it had the form of an about 10 cm wide arch. To its folded and thus considerably longer peripheric border the intestine was attached, and in its central border ran the superior mesenteric artery and vein. Through the great aperture posterior to the free part of the

mesentery the entire small intestine had passed twice, thus a firm torsion of  $720^\circ$  had taken place at both ends. Owing to the circulation of venous blood being impeded by the torsion, the portion of intestine which had passed through the aperture was filled with blood and there was incipient gangrene. In the second case about 60 cm of the sigmoid flexure and about 250 cm of the ileum had passed through an aperture, of the size of two finger-breadths, situated in the ileo-cecal angle; either of these had, furthermore, twisted independently into a volvulus, and had become gangrenous. In both cases the mesenteric apertures seemed to be congenital. In neither case did the past history state previous fits of pain which might be considered passing attacks of occlusion. Both patients died of shock, the one in the beginning of the anesthesia, and the other during the operation. In agreement with FEDERSCHMIDT mesenteric defects should be considered atavistic products of the same rarefaction process to which the ventral mesentery of the human body is regularly subjected. 97 similar cases have been described in the literature. In these the mortality rate was about 33 per cent (out of 73 cases).

### Zusammenfassung.

Die Untersuchung fusst auf zwei Fällen von Okklusion. Im ersten Falle war das Mesenterium des Dünndarms nur an beiden Enden (in der Nähe des Lig. Treitz und der Ileozäkalklappe) an der hinteren Bauchwand befestigt. Zwischen diesen Punkten hatte es die Form eines etwa 10 cm breiten Bogens. An seinem faltigen und also bedeutend längeren Aussenrande war der Darm befestigt, und an seinem Innenrande verliefen die Arteria und Vena mesenterica sup. Durch die grosse, hinter der freien Partie des Mesenterium gelegene Öffnung war der gesamte Dünndarm zweimal durchgeschlüpft, so dass an beiden Enden eine feste Torsion von  $720^\circ$  stattgefunden hatte. Infolge der durch diese Torsion bedingten Abflusstörung des venösen Blutes war die durch die Öffnung hindurchgegangene Darmpartie voll von Blut und zeigte beginnende Gangrän. Im zweiten Falle waren etwa 60 cm der Flexura sigmoidea und etwa 250 cm des Ileum durch eine doppelt fingerbreite Öffnung im Ileozäkalwinkel geschlüpft; ferner hatten sie sich beide unabhängig gedreht, so dass ein Volvulus entstand, und waren gangränös geworden. In beiden Fällen

schien die Öffnung im Mesenterium angeboren zu sein. In der Vorgeschichte wurde in beiden Fällen über keine Schmerzanfälle berichtet, die als vorübergehende Okklusion aufgefasst werden können. Beide Kranken starben an Schock, der eine bei Beginn der Betäubung, der andere während der Operation. In Übereinstimmung mit der Ansicht FEDERSCHMIDT's sind mesenteriale Defekte als atavistische Folgen desselben Rückbildungsvorgangs anzusehen, dem das ventrale Mesenterium beim Menschen regelmässig anheimfällt. Im Schrifttum sind 97 ähnliche Fälle beschrieben. Bei diesen betrug die Sterblichkeit (unter 73 Fällen) ca. 33 %.

### Résumé.

Cette étude est basée sur deux cas d'obstruction. Dans le premier, le mésentère de l'intestin grêle n'était fixé à la paroi abdominale postérieure que par ses deux bouts, au voisinage du ligament de Treitz et près de la valvule iléo-caecale. Entre ces deux points il avait la forme d'une arche longue d'environ 10 cm. L'intestin était attaché à son bord périphérique qui était plissé et considérablement plus long, et l'artère ainsi que la veine mésentériques supérieures couraient à l'intérieur de son bord central. L'intestin grêle tout entier avait passé deux fois à travers la grande ouverture en arrière de la partie libre du mésentère, causant ainsi une torsion serrée de  $720^{\circ}$  à ses deux extrémités. La circulation veineuse étant gênée du fait de la torsion, la partie de l'intestin quit avait passé par le hiatus s'était remplie de sang, et il y avait un début de gangrène. Dans le second cas, environ 60 cm. de l's iliaque et à peu près 250 cm. de l'iléon avaient passé par une ouverture, de la largeur de deux doigts, située à l'angle iléo-caecal: de plus, chacun de ces deux segments intestinaux s'était de son côté tordu en volvulus et gangrené. Dans les deux cas l'ouverture du mésentère semblait être d'origine congénitale. Dans l'un comme dans l'autre l'anamnèse relevait des accès douloureux antérieurs, qu'on pourrait considérer comme des crises passagères d'obstruction. Les deux malades moururent de shock, le premier au début de l'anesthésie, le second pendant l'opération. Avec FEDERSCHMIDT on devrait considérer les lacunes du mésentères comme le résultat, atavique, du même processus de raréfaction auquel le mésentère ventral du corps humain est



normalement sujet. 97 cas semblables ont été décrits dans la littérature. Le taux de leur mortalité a été d'environ 33 % (sur 73 cas).

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## A Clinical and Pathological Anatomical Study of Tumours of the Kidney in Children, Based on a Series of 18 Cases.

By

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Loimaa.

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Of the infrequent malignant tumours in children no less than 20.4 per cent are localized to the kidney, while the corresponding figure in adults is only 0.5 per cent (F. HINMAN & A. A. KUTZMAN). The renal tumour most common in children is the so-called Wilms' tumour or *adenosarcoma renis* which is often even congenital and shows the highest incidence during the first years of life but rarely occurs in adults. According to M. F. CAMPBELL and G. W. REAGAN 66 per cent of the cases in the literature are of children under three, 75 per cent of children under five and, according to E. T. BELL, 90 per cent of children under seven years of age. These tumours are peculiar to childhood. It illustrates their frequency that they occurred in 0.13 per cent of the total number of patients admitted during 21 years to the *Children's Hospital* in Boston (CH. MIXTER), in 0.096 per cent of all cases of malignant tumours treated in the *Department of Urology* of the Memorial Hospital of *Cancer and Allied Diseases* during 13 years and only in 0.068 per cent of the 20,470 children included in H. L. KRETSCHEMER's autopsy statistics. These estimates are made from selected case material; if the *total number of patients* during 40 years of the Mayo Clinic is considered, the percentage is only 0.004. In view of this it is easy to understand that the published series are small and include only a few cases. The statistical series of the gigantic American hospitals form the only exceptions, in that *e. g.* 26 cases are reported from Cleveland (C. C. HIGGINS &

F. L. SHIVELY), 35 from the Hospital of Johns Hopkins University (C. F. GESCHICKTER & H. WIDENHORN), 60 from the Children's Hospital in Boston (W. E. LADD & R. R. WHITE) and no less than 109 cases (J. T. PRIESTLEY & A. C. BRODERS 65, W. WEISEL, M. B. DOCKERTY & J. T. PRIESTLEY 44) from the Mayo Clinic. From Finland A. KROGIUS has published 1, L. J. LINDSTRÖM 4 and T. G. NYSTRÖM likewise 4 cases (besides 2 cases of renal sarcoma in children published by G. HEINRICIUS and 3 by L. J. LINDSTRÖM). The total number of world cases published is presumably well over one thousand, G. W. REAGAN having found 1,037 on record already in 1938. The present investigation is based on 18 hitherto unpublished cases, 9 of which are from the Children's Clinic of the Helsinki General Hospital (incidence 0.18 per cent), 4 from the Vaasa Provincial Hospital, 2 from the General Hospital in Savonlinna and 1 each from the Hatanpää Hospital, the Mikkeli Provincial Hospital and the 30th War Hospital. The author's thanks are due to the chiefs of these hospitals for their courtesy in permitting him to use the case reports. He is also greatly indebted to the Prefect of the Institute of Pathological Anatomy in the Helsinki University, Prof. ARNO SAXÉN, for his advice while working out the pathological anatomical part of this work.

## Clinical part.

### Author's case material.<sup>1</sup>

Ten of the patients were boys and eight girls. In the statistics compiled from the literature by REAGAN both sexes were equally represented. The age of the patients at the time of diagnosis varied between two months and eight years. In the youngest patient the symptoms appeared shortly after birth, so in this case the tumour must have been congenital. The incidence in all cases was unilateral, with the possible exception of No. 15 in whom a tumour (recurrence?) was observed shortly after operation on the

Table No. 1.

<1 yr.	1<2 yrs.	2<3 yrs.	3<4 yrs.	4<5 yrs.	5<6 yrs.	6<7 yrs.	7<8 yrs.	8<9 yrs.
3	5	3	2	1	2	1		1

<sup>1</sup> In order to save space the author has excluded the case reports; all facts given in them appear in the text and the appended tables.

other side. It was, however, not operated, and no attempt was made to clear up the case by a post-mortem examination.

### Symptoms.

The anamnesis is sometimes long and sometimes very short, depending on the rate of the tumour's growth. The first symptoms are usually anorexia, listlessness, loss of weight, anaemia and a slight rise of temperature. Because of their general nature these symptoms often do not sufficiently attract the attention of the parents. When the child is finally brought for medical examination it is usually definitely pale and thin, its stomach is swollen and as a rule the tumour can already be distinctly felt. Often only the alarm caused by its accidental discovery by the parents induces them to seek medical help. Pain, at least in a severe form, is not an early symptom of this complaint as it appears generally very late, denoting then either intra-tumoral haemorrhage or infiltration of the adjacent regions resulting in inoperability (L. J. LINDSTRÖM). Pain is also felt in connection with metastases. A few cases have been presented in the literature, where the violent pain produced by a spontaneous rupture of the tumour was the first distinct symptom (F. K. BOLAND, E. W. LEXER, L. J. LINDSTRÖM, O. ORTH). Varicocele and dilated veins in the frontal abdominal wall are late and, at least the former, rare symptoms. They are caused by the compression of the v. spermatica, v. renalis or vv. lumbales and v. cava inferior through the tumour and its metastases or by the formation of a tumour thrombus within the lumen of these veins (HOCHENEGG, L. J. LINDSTRÖM). Haematuria, a frequent early symptom of Grawitz' tumours, is very rare: (M. F. CAMPBELL reports an occurrence of 15 and GRAUHAN of 20 per cent, J. T. PRIESTLEY & A. C. BRODERS 17.4 per cent as first symptom but 43.4 per cent at some other stage of the disease). This cannot be due to the fact, as contended by *inter alia* T. G. NYSTRÖM and C. G. BANDLER & PH. R. ROEN, that the tumour grows for a long time enclosed in its capsule without breaking through into the renal pelvis because this feature is also typical of the hypernephromas. The most probable source of the bleedings (according to L. J. LINDSTRÖM) are the ruptures in the capillaries of the glomeruli originating in the venous stases caused by the tumour growing inside the renal capsule. Haematuria being less frequent in connection with Wilms'

Table No. 2.

Symptom	Discovered at home	Discovered on admission	Total
Abdominal swelling . . . . .	11	2	13
Anaemia . . . . .	10	7	17
Anorexia . . . . .	4	0	4
Loss of weight . . . . .	10	3	13
Fever . . . . .	8	1	9
Vomiting . . . . .	3	0	3
Diarrhoea . . . . .	5	0	5
Urination urgency . . . . .	2	1	3
Haematuria . . . . .	5	0	5
Abdominal or lumbar pain . . .	7	0	7
Tumour . . . . .	9	8	17
Visible dilated veins . . . . .	1	2	3

than with Grawitz' tumours may in the author's opinion be simply explained by the fact that the veins in children, in whom the former disease is chiefly found, are healthier and more elastic and thus more resistant to pressure than those of adults of whom the latter complaint is typical. The urgency of urination on the other hand mostly seems to arise from a simultaneous infection of the urinary paths (LINDSTRÖM).

Vomiting, diarrhoea or, on the contrary, obstipation also occur but generally not before other symptoms have already led to diagnosis. Hypertonia was found in patients with Wilms' tumour by B. S. ABESHOUSE & T. WEINBERG and W. WEISEL, M. B. DOCKERTY & J. T. PRIESTLEY.

The incidence of the various symptoms in the author's material appears from Table 2. It may be noted in this connection that only in 11 of the patients was the blood examined and of these 8 suffered from hypochromic and 3 from normochromic anaemia. They do not show any regularity of the blood picture. The frequent occurrence of haematuria is apparently only accidental and this in a series of so few cases may deprive the frequency calculation of all importance. Half of the patients showed a rise of temperature before operation, which corresponds to the proportion reported by other researchers (J. T. PRIESTLEY & A. C. BRODERS 52.2, M. F. CAMPBELL 50 and C. C. HIGGINS & F. L. SHIVELY 42 per cent). The fever was remittent. J. ISRAEL and M. NEU consider this rise of temperature an anaphylactic phenomenon caused by the albumen emitted by the tumour, and the same view is taken by L. J. LINDSTRÖM who rejects the idea only

I have thought fit to group listlessness, anorexia, loss of weight and anaemia under the expression "general symptoms" as they usually appear simultaneously. Patient No. 9 was admitted to hospital because of parotitis and myxoedema, the kidney tumour being found during treatment. In No. 16 the tumour was observed as a first symptom already at home but was diagnosed as splenomegalia and treated as such in hospital. Re-admission was due to a decline of the general condition and the correct diagnosis was only made a couple of weeks later.

The table also shows the period from the appearance of the first symptoms to the diagnosis and beginning of treatment, or in other words the time lost by each patient. Only in Patient No. 13 did the initial symptom, haematuria, lead to immediate consultation of a doctor, diagnosis and operation so that here the loss was almost nil, in all the rest it varied between 3 weeks and 10 months, the average being 4 months. Naturally the prognosis had by then in many cases become much less promising, probably decisively so. This was due not only to lack of enterprise in the parents, as the disease in eight cases began with slow insidious general symptoms and the cause in eight more was a wrong diagnosis. In the latter cases in the time expression the first factor denotes the interval between the observation of the first symptoms and the first medical examination and the second factor the time between the latter and when the correct diagnosis was made and treatment begun. In Patients No. 5 and 6 those periods even in spite of two wrong diagnoses were limited to 3 and from 5 to 6 weeks respectively, thanks to the perseverance of the patients' mothers in consulting one doctor after another. The reverse is seen in the Cases Nos. 1 and 10 where the parents, although they noticed the swelling of the child's abdomen, only presented it for medical examination after 5 and 10 months respectively, and No. 16 where the mother left it until 1 month after having discovered the tumour.

### Differential diagnosis.

In the beginning the symptoms of Wilms' tumour are less conspicuous than those of other renal tumours, and even at later stages it shows no specific pathognomonic symptoms or symptom groups. This makes differential diagnosis difficult. Before the tumour is palpable it may be mistaken for almost any ordinary

Table Nr. 4.

Case No.	Side	1st examination	2nd examination	3rd examination	4th examination	Time lost
1	right	healthy				8 mos.
4	left	asthenia	no diagnosis	splenomegalia	splenomegalia	10 mos.
5	right	bladder disturb.	bladder disturb.	no diagnosis		21 days
6	right	bronchitis.	pleuritis			28 days
8	left	infectio ac.	splenomegalia			14 days
9	left	not discovered				0
10	right	no diagnosis				7 days
16	left	splenomegalia				4 mos.
17	right	healthy	pyelitis			9 mos.
Average 3 mos. 21 days						

disease of the stomach. Especially when there is haematuria it may be confused with so-called essential haemorrhage from the kidney, renal calculus and tuberculosis, papillomas of the bladder and kidneys etc. When the tumour has grown big enough to be felt the changes of its being misinterpreted are in fact still greater, as besides diseases localized to the kidneys: hypernephromas, renal carcinomas and sarcomas, hydronephroses, pyonephroses and various kinds of cystic kidneys as well as perirenal abscesses, numerous other complaints productive of resistance in the stomach have to be considered: tumours of the liver, the pancreas, the intestine and the ovaries, further cysts of the omentum and the mesenterium as well as dermoid and retroperitoneal cysts, neuroblastomas etc. However, differential diagnosis in children is facilitated by the fact that, with the exception of neuroblastomas, the diseases mentioned above are as a rule afflictions belonging to a more advanced age. Besides, even if a wrong conclusion is made concerning the nature of the tumour, no great harm is done since the treatment is in any case surgical. This is different in the case of an erroneous diagnosis of splenomegalia, which may easily happen if the tumour is left-sided and smooth. In the present series this mistake was made in three cases, in one of them (No. 4) even twice and each time in a different hospital. The erroneous diagnoses and the ensuing loss of time appear in Table 4.

If diagnosis is uncertain, the renal nature of the tumour may in most cases be proved by roentgen examination. This is often possible even without the use of an opaque agent as in the author's cases Nos. 11 and 12. Thus E. KEY has succeeded in rendering even non-palpable tumours visible. Yet the results obtained by



roentgen with the aid of an opaque agent are, of course, more reliable. As the patients are mostly children retrograde pyelography may be difficult to carry out and even the intravenous urography may not be practicable. In that case the opaque agent may be given by the intramuscular or, when sufficiently diluted, by the intraosseal or even the subcutaneous method (C. C. HIGGINS & F. L. SHIVELY). The changes are either characteristic of renal tumours in general (Case No. 8) or the pelvis does not fill at all owing to the renal function being completely absent (Cases Nos. 4 and 15). Urography should always be carried out as it proves the functional fitness of the other kidney and prevents the removal of a possible solitary organ (J. ALBARRAN & L. IMBERT's case! E. L. ELIASSON & L. W. STEWENS' case of horseshoe kidney!)

M. F. CAMPBELL and P. S. ADAMS & H. B. HUNT favour aspiration biopsy by means of which a definite histological diagnosis is achieved. It seems, however, that this method should be discarded on account of the danger of metastases (A. DEAN & G. PACK, D. H. KERR *et al.*).

### The treatment and its results.

The standard treatment of Wilms' tumour is still surgical extirpation of maximum radicality, but it is now mostly combined with roentgen therapy. In some cases even radium has been tried.

Formerly the operative approach was made exclusively through the classical, lumbar, retroperitoneal incision, but nowadays, especially in the case of large tumours, it has been superseded by the ventral transperitoneal approach (W. E. LADD, F. LIEBERTHAL, J. FRASER, H. HAUSER, K. BRAUN, C. F. GESCHICKTER & H. WIDENHORN, G. B. PACKARD & A. BLUMBERG *et al.*). Although L. J. LINDSTRÖM contends that even the most difficult tumours may be removed in the posterolumbar way ("selbst die schwierigsten Geschwülste sich auf lumbalem Wege entfernen lassen"), it nevertheless seems obvious that at least the handling of the renal pedicle, usually the most difficult item of the operation, is easier from the frontal side. It is to be noted that in order to prevent the loosening of tumour thrombi (which H. ENGELKE, H. MERKEL, L. J. LINDSTRÖM and N. NEVINNY have observed to reach even the heart by way of the v. renalis and the v. cava inferior) the v. renalis has to be ligatured before the actual tu-

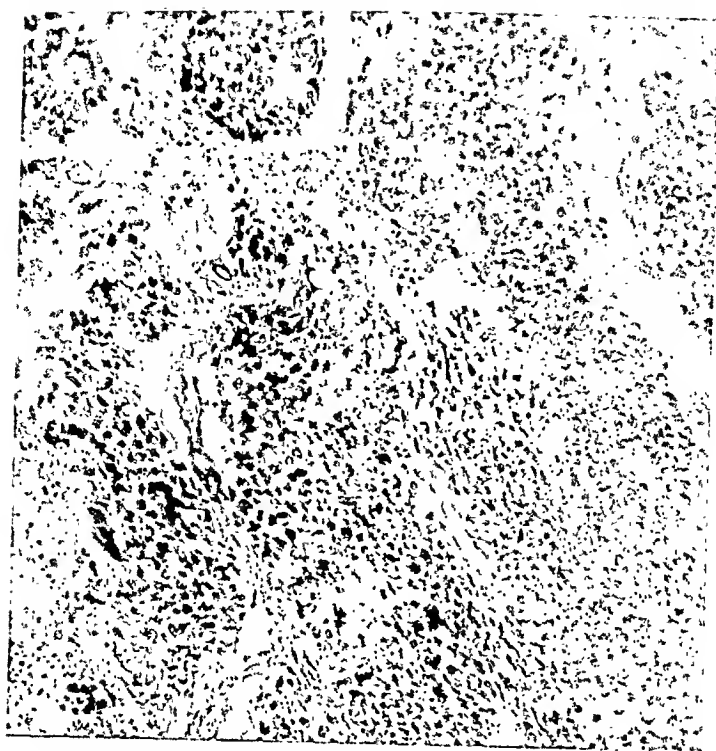


Fig. 1. Case No. 8. Not even the most elementary cell grouping. Same type of tumour also in Cases Nos. 3 and 10.

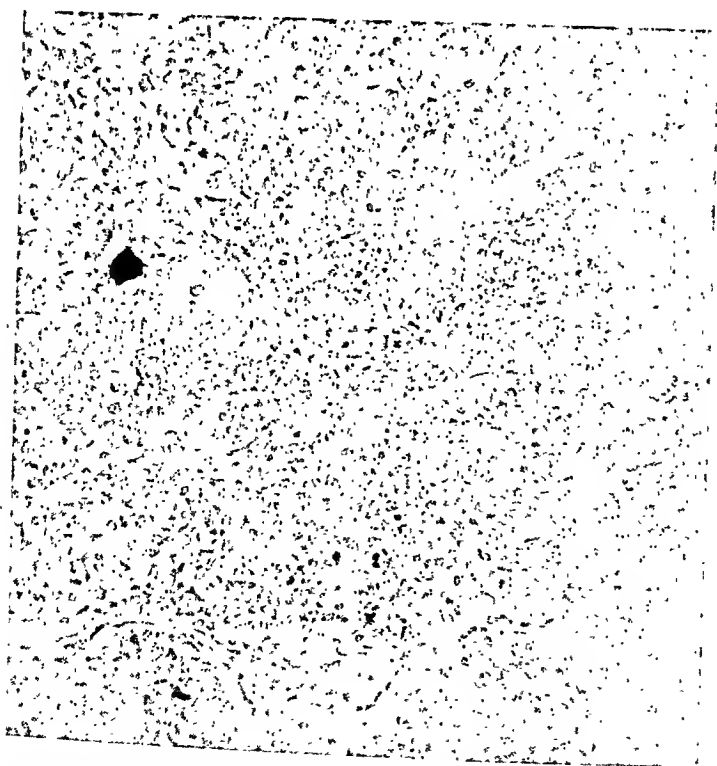


Fig. 2. Case No. 4. Slight alveolar cell grouping but no actual tubulus or glomerulus formations. Same type of tumour in Cases Nos. 14 and 15.

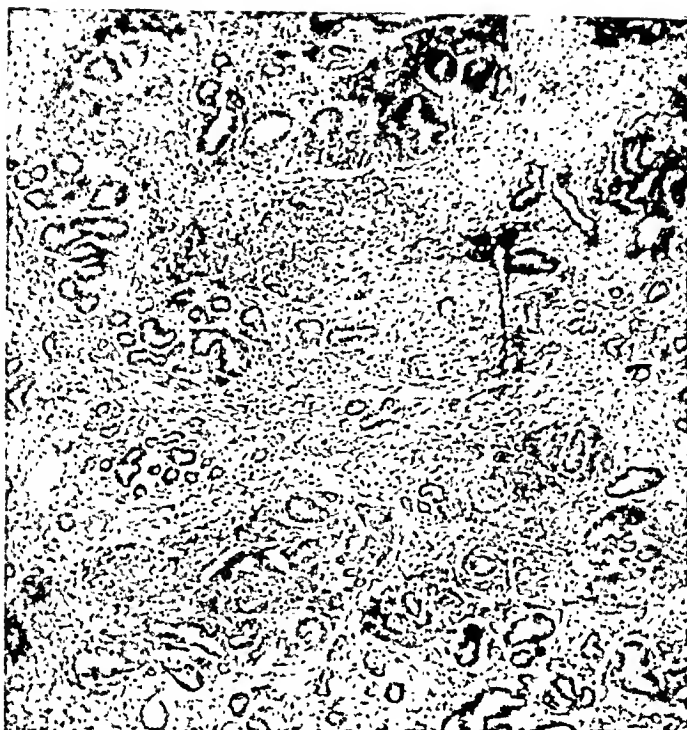


Fig. 3. Case No. 2. Distinct tubulus formations but not even the most elementary glomerulus formations. Same type of tumour in Cases Nos. 5, 11, 12, 13, 17 and 18.

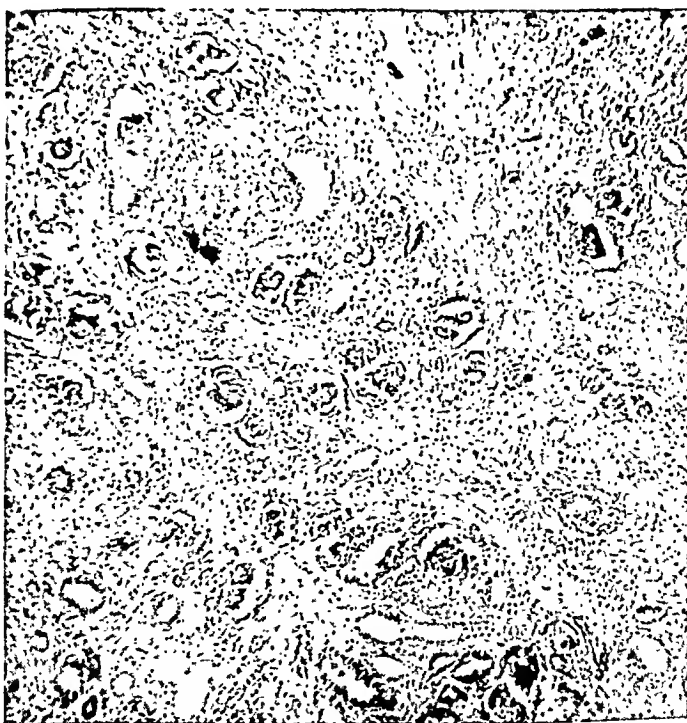


Fig. 4. Case No. 9. Both tubulus and glomerulus formations. Same kind of tumour in Case No. 1.

mour is released and for the same reason should previously be opened for inspection and, when necessary, emptied.

With the aid of transfusion (a most important supplementary measure as children are sensitive to loss of blood) and modern, more lenient methods of anaesthetization it has become possible to reduce considerably the immediate operative mortality which was formerly very high, averaging 28 per cent as calculated by F. HINMAN & A. A. KUTZMAN in 1924. Thus W. E. LADD reports an operative mortality during the last 10 years of only 2:28 and in the last series of the Mayo Clinic it was only 1:44. The ultimate mortality from recurrences and metastases is still enormous. Among 756 cases collected from the literature, G. NEUMEYER in 1939 found only 17 patients living and healthy after 5 years, the percentage of cures in children being only 2.25.

Roentgen therapy was already mentioned above. Wilms' tumours are highly radio-sensitive, even to such an extent that H. L. KRETSCHMER ascribes a definite diagnostic importance to this condition and contends that tumours which do not rapidly decline under roentgen treatment are not adenosarcomas of the kidney. In opposition to this P. S. ADAMS & H. B. HUNT point out that medulloblastomas which are nearest at hand from the point of view of differential diagnosis respond still more readily to radiation therapy. In spite of its positive primary effect it has not been possible to achieve a notably better prognosis through roentgen treatment. A considerable part of the patients in G. NEUMEYER's statistical series had been treated with roentgen also and in the extremely large literature treating of Wilms' tumours only three cases are found in which a cure was effected exclusively by such treatment (POHLE & RITCHIE, W. H. McNEIL & A. J. CHILKO). It should also be noted that their diagnosis has not been verified by histological examination. Also the majority of European researchers consider the combined treatment useless (K. BRAUN, G. NEUMEYER, E. ROEDELIIUS and others). S. BERGLUND and T. G. NYSTRÖM recommend it in order that all should be done. The Americans, on the other hand, do not take this pessimistic and negative view. They usually give roentgen treatment for three to six weeks prior to operation (D. H. KERR, C. F. GESCHICKTER & H. WIDENHORN, A. DEAN & G. PACK, L. R. WHARTON, RANDALL and others) or so long as it causes the tumour to decline in size (W. WEISEL, M. B. DOCKERTY & J. T. PRIESTLEY). Some surgeons use roentgen treatment before as well as

Table No. 5.

Case No.	Received roentgen treatment		Time after operation	Living State of health	Died Cause of death
	postopera- tively	to recur- rence			
1 . . .	—	—	3½ mos.	healthy	recurrence
2 . . .	—	—	3 yrs.		
3 . . .	—	—	0		oper. shock
4 . . .	—	—	1 mo.		sepsis etc.
5 . . .	+	+	49 days	healthy	recurrence
6 . . .	+	+	5 mos.		recurrence
7 . . .	+	—	2 yrs.		
8 . . .	+	—	3½ mos.		recurrence and metastasis
9 . . .	+	—	1 yr 5 mos.	recurrence	
10 . . .	—	+	2½ mos.	healthy	recurrence
11 . . .	—	—	4 yrs.		
12 . . .	—	—	1 yr. 2 mos.		recurrence
13 . . .	+	—	2 mos.		diarrhoea (roent- gen?)
14 . . .	—	—	1½ mos.		recurrence
15 . . .	—	—	3 mos.		recurrence
16 . . .	—	+	1 yr. 4 mos.		lung metastasis
17 . . .	—	—	0		oper. shock
18 . . .	—	—	1½ mos.		recurrence

after operation (H. L. KRETSCHMER, REED, POHLE & RITCHIE, C. G. BANDLER & PH. R. ROENS). The number of cases in the different series is as yet so small that conclusions would be precipitate. As regards dosage the reader is referred to the studies by POHLE & RITCHIE and BERGLIND.

E. FOSTER & J. MENDILAHARZI and F. BESSER & F. AMAN-JEAN have tried radium treatment. Using laparotomy both these pairs of investigators placed radium tubes inside the tumour and thus actually caused it to disappear, the first two achieved the same result even in a case of later local recurrence. Their patient was symptom-free when their publication appeared, ten months after the last treatment; the patient of the latter pair escaped recurrence but died of metastases in the lungs.

In all the patients of my series the tumour and the diseased kidney were removed under ether — five the transperitoneal way and thirteen the retroperitoneal — without preoperative roentgen treatment. Two of them died immediately following the operation and one succumbed later owing to complications. The fate of the patients appears from Table 5. The only necessary comment on this Table seems to be that up till now only two patients (Nos. 2

and 11) can be regarded as definitely cured; neither of them had received roentgen treatment. The time elapsed since the operation of the others is too short to allow of conclusions with regard to the cure.<sup>1</sup> According to W. E. LADD recurrences and metastases occur within 1½ year after operation. In five cases roentgen therapy proved quite ineffective and in four it did not prevent recurrence. Taking into account L. J. LINDSTRÖM's four cases and T. G. NYSTRÖM's one case who were given postoperative roentgen treatment, it can be stated that the experience in Finland of postoperative roentgen therapy is very limited but completely negative.

## Pathological anatomy.

### Macroscopic anatomy.

Wilms' tumours vary considerably in appearance. Some are quite solid, knobbed, and may even contain cysts of different sizes, others are pseudo-fluctuating, consisting of a soft, pasty mass held together solely by a tight, seemingly too small capsule. The section surface of the latter type is of a yellowish or reddish grey, according to the amount and freshness of haemorrhage. In the former type its colour is more variegated, although not so much as in the hypernephromas, but nevertheless enough to show clearly the lobular structure consisting of different kinds of tissue found in this type of tumour. Thus it shows more or less grey, yellowish or reddish areas. Fat formations, necrosis and haemorrhage are usual features. Common to both types and their numerous intermediate forms is the capsule which for a long time separates the tumour tissue not only from its environment but also from the healthy renal tissue. Reduced by compression to a thin layer, the remaining portion of the latter may cover a large or small part of the tumour, or it may form a segment-like appendix beside it, the localization of which depends on the part of the kidney in which the tumour originated.

The present material includes both types of tumour. Unfortunately, however, the case reports were in some instances very defective (Nos. 7 and 15) or altogether missing as were also the specimens (Nos. 10, 12, 13) so that the ratio between the types could not be determined. On comparison the periods elapsing in

<sup>1</sup> Supplement under proof-reading: one of them (No. 7) is still healthy 2 yrs. after the operation but the other (No. 9) has been taken ill with recurrence. Table No. 5 has been rectified and is thus correct.

the remaining cases between the appearance of the first symptoms and the diagnosis and between operation and recurrence show no differences that would justify the assumption of a greater rapidity of growth in one type than in the other. Infiltrating growth was found in both kinds of tumour. The tumour emitting metastases of the lung belonged to the solid type.

### Microscopic anatomy.

The histological picture of these tumours may vary enormously. The tissue of the simplest types consists of a very undifferentiated cell structure suggestive of a globocellular or fusocellular sarcoma, richly nucleate and forming streaks and whirls, traversed by thinner or thicker septa of connective tissue which may, however, be altogether absent. In some types cells of this tissue may be grouped alveolarly leaving small openings between them lined with cubical or cylindric cells arranged in one or two or even in three regular rows. Thus these cell islets have a primitive gland-like structure and the tumour seems to consist of intermingled regions of tissue suggestive of adenocarcinoma and sarcoma. Hence the name adenosarcoma. In the more mature forms the differentiation may have proceeded so far that those rudimentary "glandular tubes" resemble the canals of the mesonephros and may even include formations suggesting glomeruli. Some cases abundant in these formations have in the literature been called glomerulomas, having been mistaken for tumours originating in the glomeruli. The cells of the intervening stroma may also be so far differentiated that they resemble the cells of embryonic or even more mature connective tissue. In that case abundant collagenous (probably also elastic) fibres may even be found here and there. The same applies to more or less mature smooth or striated muscle cells. These cells may be so profuse as to be dominating and it may be really difficult to find adenomatous elements. Thus, when these tumours were first described they were erroneously called myosarcomas. Previously striated muscle fibres were regarded as characteristic of Wilms' tumours but we do not now consider them indispensable for this diagnosis (O. LUBARSCH). According to F. LIEBERTHAL their occurrence in this kind of tumour is only 40 per cent. The most mature of these growths are seen to contain fat and cartilage tissues and even islets of bone. H. RIBBERT, B. MASSON and F. HARBITZ even

found nerve tissue. Therefore in the opinion of the last of these investigators the adenosarcomas are to be regarded as neuroblastomas. Yet the various kinds of tissue found in the tumour are not sufficiently differentiated and the structure of their tissue is never so mature that they can be considered histologically benignant and comparable to teratomas with their complete organs.

The present series of cases also includes tumours representing widely differing stages of maturity from quite undifferentiated sarcomatous forms to maturer, adenomatous types containing elements of renal tubules and glomeruli. However, the author has not found clearly striated muscle, cartilage or bone in any of his cases. On the other hand one tumour (Case No. 3) contained obvious, thickish nerve fibres. The possible frequent presence of elements of nerve tissue and the correctness of HARBITZ' contention concerning medulloblastomas could not be verified as the author could not avail himself of the necessary colouring method, the specimens not being specially fixed for that purpose. As, moreover, he has had no opportunity of preparing large sectional series because — with the exception of the very recent, which were preserved whole — a few paraffin blocks in the collections of the Helsinki University Institute of Pathological Anatomy are all that is left of the extirpated growths, it seems unnecessary to attempt here a detailed histological analysis of Wilms' tumours. This has been so often and so thoroughly done that it would hardly be possible to contribute new facts. It should therefore suffice to describe the division of the tumours in the author's material into different structural types illustrating the facts by a short histo-pathological description and a few microscopic photographs and using as a basis for their classification the degree of maturity attained by their epithelial parts, as it should be noted that the epithelial and the sarcomatous parts do not, by any means, mature along parallel lines.

*Case No. 8.* The kidney and tumour tissues are divided by a fibrous capsule, containing in places abundant hyalized glomerular remains. In the tumour tissue proper are found very thin septa made up of mature collagenous connective tissue and containing smooth muscle cells. The intervening tissue consists of obviously epithelial cells very poor in protoplasm but with a very large nucleus rich in chromatin. The epithelial islets formed by them have a lighter colour in the centre than near the edge, as the cells, owing to the oedema, are fewer in that part and the nuclei less tinged. They do not even show the most primitive attempt at glandular cell grouping. In places the tumour



tissue greatly resembles a globocellular or fusocellular sarcoma. In one specimen there is an abundance of smooth muscular structure.

*Case No. 4.* Epithelial islets in connective tissue which is in part very loose and immature, and in parts denser and more mature containing even somewhat collagenous fibrils and primitive smooth muscle cells. Here we find a slight alveolar structure of the cell grouping which, however, has nowhere attained distinct tubular formation.

*Case No. 2.* The connective tissue forming the sarcomatous part of the tumour is similar to that of the previous case but the epithelial islets show a strong tendency towards glandular structure and formation of tubules. The cells so arranged are cubic or cylindrical and higher than those pertaining to the undifferentiated parts. Their nucleus is either in the centre or at the lower pole and highly coloured. Necrotic areas are found in places.

*Case No. 1.* The specimen shows wide areas of embryonal connective tissue and others consisting of smooth muscle structure. Some of the epithelial islets occurring here and there are quite undifferentiated, whereas some show, especially in their border areas, clearly perceptible glandular cell grouping as well as formations suggestive of tubules and even glomerules.

The next two cases, although unmistakable adenosarcomas, cannot, on account of their different construction, be included in any of the above groups.

*Case No. 16.* The tumour and kidney tissues are divided by a distinct fibrous capsule. In the former there are large areas of very loose, oedematous, embryonal connective tissue containing hardly any collagenous fibres. In places small cysts may be seen covered with single-layered, flat or cubic epithelium and thin tubules formed of higher epithelium. On the other hand no corresponding formations can be found in the large quite undifferentiated epithelial cell islets abounding in some parts of the tumour. In those parts the connective tissue is more mature and fairly rich in collagenous elements. Here and there haemorrhages occur.

*Case No. 7.* In loose, immature connective tissue rich in cells and containing in places a profusion of thick, short collagenous fibres and some amount of smooth muscle cells there are numerous small cysts of the same kind as in the previous case lined by low cubic epithelium. No epithelial islets clearly separated from the connective tissue can be discerned but in some places the connective tissue is denser and the form and nuclei of its cells resemble the epithelial cells characteristic of Wilms' tumours. Although they do not otherwise show alveolar grouping there are here and there among them distinct tubules of which all the intermediate forms may be regarded as a transition to the cysts mentioned above.

The construction of the tumour of the following case differs from that of the previous type to such a degree that it may perhaps be thought questionable whether it should be classed among Wilms' tumours at all. As, however, it includes both epithelial and mesenchymal elements and among the latter an abundance of smooth muscle fibres, the author has considered it right to count it among them.

*Case No. 6.* The tumour parenchyma is medullary and only here and there may feeble attempts at alveolar grouping be noticed. The cells are rounded or polygonal with nuclei poor in chromatin. In them mitoses are especially abundant. Connective tissue is scanty. It is collagenous, partly immature and partly somewhat maturer, and forms quite thin septa and thickish rods. Between this tumour tissue and the sclerotic tissue of the kidney there is a strong fibrous capsule showing here and there a profusion of hyalinized glomerular remains.

No marked differences in malignity can be clinically observed between the histologically different types. Nor do such differences seem to be noticeable between tumours occurring in patients of different ages, although it has been maintained that the most mature and at the same time most slowly developing varieties appear chiefly in adults. The present material is, however, too small and too one-sided, consisting only of children, to allow of definite conclusions.

Yet there is one circumstance which in the author's opinion requires further discussion. In Cases Nos. 8, 10, 12 and 17 numerous sclerosed glomerulus remains were found in the connective tissue capsule enclosing the tumour and kidney tissue. A further feature common to all these cases is that the renal tissue nearest to the capsule appears compressed and in places without a clear division changes into the capsule in such a manner that the epithelial elements become more and more atrophied while there is an accumulation of the interstitial connective tissue. L. J. LINDSTRÖM has made the same observation (regarding both sarcomas and hypernephromas), as has also C. STERNBERG. Accordingly one seems justified in surmising that the capsule has developed from the renal tissue through sclerosis of the connective tissue due to the pressure exerted by the weight of the tumour growing inside the renal capsule. The fact that remains of renal tubules and glomeruli are found even in the connective tissue septa of the tumour adjacent to the "capsule" (Cases Nos. 10 and 12) is an additional proof that we do not have here a capsule in the strict sense of the

word. Thus the growth of the tumour is really always infiltrative. The expansive growth of some tumours is only apparent and due to the sclerosed boundary wall having had time to develop, owing to their slow growth, between the tissues of the tumour and the kidney. In rapidly progressing cases the wall remains incomplete (Cases Nos. 6 and 10) or does not develop at all (Cases Nos. 5, 14 and 15) and the infiltrative manner of growth is thus clearly discernible.

The metastases are generally described as having a simpler construction than the primary tumours, being as a rule purely sarcomatous, but even in them one finds represented all the types of tissue characteristic of the primary tumour. The author's material does not include specimens of metastases as no post-mortem examination was made of the only case (No. 16) showing unmistakable metastasis.

### Pathogenesis.

The peculiar construction of Wilms' tumours has induced many investigators to attempt the explanation of their pathogenesis. According to the alleged origin of the tumour tissue the numerous existing theories may be grouped as follows:

1. Origin attributed to the mesoderm prior to its division into myotomes, sclerotomes and nephrotomes (J. COHNHEIM, M. WILMS, H. RIBBERT, M. HERZOG & D. LEWIS, R. MEYER and L. B. WILSON) in such a manner that, at the segmentation of the nephrotome, mesodermal cell tissue would accompany it and have the faculty of differentiating later into all the cell types of connective tissue. According to M. WILMS and M. HERZOG & D. LEWIS this aberrant cell tissue would spread from the mesonephros to the metanephros together with the Wolffian duct. R. MEYER assumes the spreading to be due to irregular combinations of cells ("illegale Zellverbindungen"). H. RIBBERT presupposes some kind of cell migration involving also neurodermal cell tissue and further inward-growing urether branches. Differing from the others L. B. WILSON presumes that the defective segmentation takes place in connection with the metanephros and not with the mesonephros.

2. Origin attributed to mesonephros' remains entering the metanephros (C. J. EBERTH and F. V. BIRCH-HIRSCHFELD).

3. Origin attributed to the metanephros proper during some

early stage of evolution. This theory was developed by B. R. MUUS, O. BUSSE, J. EWING, J. FRASER, C. F. GESCHICKTER & H. WIDENHORN, F. LIEBERTHAL and G. W. NICHOLSON. L. J. LINDSTRÖM is also among its supporters. These writers presume that the different kinds of tissue have developed through metaplasia from the round and the smooth muscle cells of the renal anlage. G. W. NICHOLSON pertinently formulates their teaching as follows: The tumour, as I conceive it, does not arise in a malformed organ, but represents — and is — the malformed organ.

Several researchers, *e. g.* R. MEYER, F. HINMAN & A. A. KUTZMAN, A. DEAN & G. PACK and L. J. LINDSTRÖM suggest that tumours showing different stages of maturity may have arisen in different ways and during different periods of embryonal development.

G. A. MCCURDY holds the view that the toxic substances absorbed from the blood of the mother during pregnancy and the chronic nephritis caused by them in the foetus are tumour-producing properties.

The author's personal opinion is that the origin of the tumour is not to be sought in the Wolffian body as it should in that case above all be localized to the organs into which the remaining part of that body is transformed. Consequently it should appear in the male in the epididymis and in the female in the epoophoron. If further the Wolffian duct has the alleged capacity of transferring tumour elements, they ought also to be found in the ductus deferens and the vesicula seminalis in the male and in the paroophoron as well as between the leaves of the ligamentum latum on either side of the uterus and vagina in the female. In reality mixed tumours are, however, extremely rare in these localities. On the other hand they do occur in the testicles. A. R. KLOSSNER has, for example, demonstrated in all the numerous testicular tumours studied by him alien ("ortsfremde") cell types, thus proving their mixed character. Therefore, as it seems improbable that Wilms' tumours are mesonephrogenous, the only remaining possibility is that they originate in the region of the metanephros proper.

### Conclusion.

The present investigation shows clearly how late — not always the fault of their families — the patients suffering from this kind of tumour come under hospital care and consequently how tragic

is their fate. And yet if the operation is performed while the tumour is still small, it has great chances of being radical as the tumour emits metastases so very seldom and late and also is late in breaking through the renal capsule. Consequently the prognosis depends decisively on an early diagnosis, and all physicians who have the treatment of children, and especially pediatricians, should therefore remember the existence of this disease. The tumour may certainly be felt already when quite small if only it is kept in mind when palpating the stomach and if at the same time the hypogastriums are examined carefully enough. All cases resembling haematuria or splenomegalia as well as unaccountable anaemias defying treatment and even cases of emaciation should be sent for examination to a hospital offering facilities for urography.

### Summary.

The investigation is of 18 cases of children from two months to eight years of age, 10 of whom were boys and 8 girls.

The first symptoms were mostly of a general nature: listlessness, anorexia and loss of weight, anaemia and a slight fever. In two cases the initial symptoms included haematuria, which also appeared later in three cases. The tumour was discovered on admission in 17 patients, in 9 of whom it had been observed already at home. The period elapsing between the first appearance of the symptoms and the diagnosis was from 1 day to 10 months, the average being 4 months. It was longest in the cases whose first symptoms were of a general nature. Wrong diagnosis or failure to discover the tumour occurred once in four patients, twice likewise in four, three times in one and four times (twice splenomegalia!) also in one patient. The time lost in this way was from 21 days to 10 months.

The tumour with its adhesive kidney remnants was removed transperitoneally in 5 patients and retroperitoneally in 13. The author favours the former method as it allows the ligaturing of the v. renalis and, when necessary, the emptying of it before mobilizing the tumour proper, thus preventing the wandering of the tumour thrombi which may be found in it. 9 patients received postoperative roentgen treatment (in 2 of the cases only after recurrence had taken place) but nevertheless they all died of recurrences. 2 of them died immediately on operation, 1 succumbed

to late complications following it, 1 died of diarrhoea (due to too powerful roentgen treatment?), 9 of recurrences 1 to 9½ months after operation, 1 of cachexia from recurrences and metastases after ten months and 1 of metastases of the lung one year and four months following the operation. 4 patients are still living, 3 of them have as yet passed the 1½ year limit but 1 has already been taken ill with recurrence.

The tumours included both the nodulous and solid as well as the smooth and pasty variety. Histologically they were of widely different types, ranging from the most primitive sarcomatous forms to such as comprise adenomatous glomerulus elements. It is not possible on the basis of the present series to determine clinically any difference in malignity between the various types. The so-called capsule should apparently be regarded as a layer of renal tissue having sclerosed into connective tissue owing to the pressure of the slowly growing tumours. Around the rapidly growing types, which are mostly of a sarcomatous nature, it has either no time to develop at all or else only defectively.

### Zusammenfassung.

Die Untersuchung umfasst 18 Kinder im Alter von zwei Monaten bis acht Jahren, darunter 10 Knaben und 8 Mädchen.

Die ersten Symptome sind vorwiegend allgemeiner Natur: Schlaffheit, Appetitlosigkeit und Gewichtsabnahme, Anämie und geringes Fieber. Bei zwei Fällen kam unter den Initialsymptomen auch Hämaturie vor, die bei drei weiteren Fällen später auftrat. In 17 Fällen wurde der Tumor schon bei der Aufnahme entdeckt, und in 9 derselben war er schon zu Hause beobachtet worden. Die zwischen dem Auftreten der ersten Symptome und der Diagnose verlaufende Zeitspanne betrug 1 Tag bis 10 Monate, durchschnittlich 4 Monate. Am längsten war sie in denjenigen Fällen, deren erste Symptome allgemeiner Natur waren. Dass eine falsche Diagnose gestellt oder der Tumor nicht entdeckt wurde, kam bei vier Kranken einmal vor, bei gleichfalls vier zweimal, bei einem dreimal und bei einem viermal (zweimal Splenomegalie!). Die hierdurch verlorene Zeit schwankte von 21 Tagen bis zu 10 Monaten.

Der Tumor und die ihm anhaftenden Nierenreste wurden bei 5 Kranken transperitoneal und bei 13 Kranken retroperitoneal ent-

fernt. Verf. zieht die erstere Methode vor, da sie die Unterbindung der V. renalis ermöglicht und, wenn nötig, die Entleerung derselben ehe der Tumor selbst abgelöst wird, wodurch man das Wandern der in ihr manchmal vorhandenen Tumorthromben verhindert. 9 Kranke bekamen postoperative Röntgenbehandlung (bei zweien derselben erst nachdem ein Rückfall aufgetreten war), doch starben sie immerhin alle an Rezidiven. 2 von ihnen starben sogleich bei der Operation, 1 ging an Spätkomplikationen nach der Operation zugrunde, 1 starb an Durchfall (durch allzu kräftige Röntgenbehandlung bedingt?), 9 an Rezidiven 1—9½ Monate nach der Operation, 1 nach zehn Monaten an Kachexie infolge von Rückfällen und Metastasen und 1 an Lungenmetastasen ein Jahr und vier Monate nach der Operation. 4 Kranke sind noch am Leben, 3 derselben haben die 1½-jahregrenze überschritten, der vierte hat schon Rezidiv bekommen.

Die Tumoren zeigten sowohl die knotige und solide als auch die glatte und teigige Schwankungsform. Histologisch waren sie von weit verschiedenen Typen, von den allerprimitivsten sarkomatösen Formen bis zu solchen, die adenomatöse Glomeruluselemente umfassen. An Hand der bisher vorliegenden Serien ist es nicht möglich, einen Malignitätsunterschied der verschiedenen Typen klinisch festzustellen. Die sogenannte Kapsel ist offenbar als eine Schicht von Nierengewebe aufzufassen, dass durch den Druck des langsam wachsenden Tumors zu Bindegewebe sklerosiert worden ist. Um die schnell wachsenden Typen, die zumeist sarkomatöser Natur sind, hat sie nicht Zeit, zur Entwicklung zu kommen, oder geschieht dies nur in lückenhafter Weise.

### Résumé.

Les recherches ont porté sur 18 enfants de deux mois à huit ans, dont 10 étaient des garçons et 8 des filles.

Les premiers symptômes étaient généraux, le plus souvent: indifférence, anorexie, perte de poids, anémie et légère fièvre. Dans deux cas ils comprenaient des hématuries, lesquelles apparurent plus tard dans trois autres cas aussi. La tumeur fut constatée lors de l'hospitalisation chez 17 malades, sur 9 desquels on l'avait déjà observée à la maison. Le temps écoulé depuis l'apparition des premiers symptômes jusqu'à l'établissement du diagnostic varia entre 1 jour et 10 mois, sa durée moyenne étant

de 4 mois. Les délais étaient les plus longs dans les cas où les symptômes initiaux avaient eu un caractère général. Chez quatre malades il arriva une fois qu'on posât un diagnostic faux ou ne sût pas découvrir la tumeur; la même erreur fut commise deux fois chez quatre sujets, trois fois chez un autre, et quatre fois chez un dernier (où l'on crut à deux reprises à une splénomégalie!). Le temps perdu de la sorte alla de 21 jours à 10 mois.

La tumeur, avec les restes du rein qui y adhéraient, fut enlevée par voie transpéritonéale chez 5 malades, et rétropéritonéale chez les autres 13. La faveur de l'auteur va au premier procédé, qui permet de lier la veine rénale et, si nécessaire, de la purger avant de mobiliser la tumeur elle-même, afin de prévenir le déplacement des thrombus tumoraux qui peuvent exister dans sa lumière. Neuf malades furent soumis à un traitement postopératoire par les Rayons Roentgen (dans deux cas il ne fut institué qu'après l'apparition d'une récurrence), néanmoins ils moururent tous d'un retour du mal. Deux décédèrent immédiatement après l'opération, un succomba à des complications consécutives tardives, un à une diarrhée (attribuable à un traitement trop violent par les Rayons X?), neuf à des récurrences de 1 à 9½ mois après l'intervention, un à la cachexie due à la récurrence et à des métastases au bout de dix mois, et un à des métastases pulmonaires un an et quatre mois après l'opération. Quatre malades vivent encore, trois ont dépassé jusqu'ici le cap des 18 mois, le quatrième a déjà eu récurrence.

Les tumeurs comprenaient aussi bien la variété nodulaire et solide que la variété lisse et molle. Histologiquement elles étaient de types extrêmement différents, allant des formes sarcomateuses les plus simples jusqu'à celles qui comprenaient des éléments glomérulaires adénomateux. Il n'est pas possible de se baser sur la série présentée pour établir cliniquement une différence quelconque de malignité entre les divers types. Il semble que la capsule, ainsi qu'on l'appelle, doive être considérée comme une couche de tissu rénal qui s'est sclérosée jusqu'à devenir du tissu conjonctif sous l'effet de la pression des tumeurs croissant lentement. Autour de celles qui poussent rapidement, et qui sont généralement de nature sarcomateuse, la capsule ou bien n'a pas le temps de se développer du tout, ou bien ne le fait que d'une façon très incomplète.



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# I N D E X A U C T O R U M.

	Pag.
<i>Torsten Jerre</i> (Hälsingborg): Eine Modifikation der Nicola'schen Operationsmethode bei habitueller Schultergelenkluxation .....	1
<i>Erling Schroeder</i> (København): Case of Spontaneous Rupture of the Subclavian Artery .....	17
<i>O. Kapel</i> (København): Cat Bite — Pasteurellosis — Halisteresis .....	27
<i>Arvid Hellstadius</i> (Stockholm): A Study of New Bone Formation Provoked by Subperiosteal Injections of Blood Plasma, Extract of Bone Marrow, etc.....	31
<i>O. Kapel</i> (København): Operative Treatment of Gallstone Ileus Without Enterotomy	54
<i>Yngve Candolin</i> (Åbo): On Diaphragmatic Hernia .....	61
<i>Philip Sandblom</i> and <i>Birger Hahn</i> (Stockholm): On Shock during the Healing Stage of Peritonitis .....	76
<i>Leif Elskind</i> (Oslo): The Problem of Hypoproteinemia in Delayed Gastric Emptying after Stomach Resection .....	81
<i>Hans Tonnesen</i> and <i>Borge Faber</i> (Næstved, Denmark): Three Cases of Osteomyelitis in Children Treated with Penicillin .....	96
<i>Evert Schildt</i> (Umeå): Low Spinal Cord Injuries Following Spinal Anesthesia .....	101
<i>O. Kapel</i> (København): A Lenient Method for Reposition of Fractures and Dislocations of the Vertebral Column .....	132
<i>O. Kapel</i> (København): An Easily Adjustable Distraction Apparatus .....	137
<i>Fredrik Koch</i> (Malmö): A Contribution to the Operative Treatment of Cancer of the Rectum .....	145
<i>Arvid Hellstadius</i> (Stockholm): An Investigation, by Experiments on Animals of the Rôle Played by the Epiphyseal Cartilage in Longitudinal Growth ....	156
<i>N. O. Ericsson</i> (Linköping): On the Frequency of Complications, Especially those of Long Duration after Spinal Anesthesia .....	167
<i>Herman Wahren</i> (Ludvika): Total Resection of the Carcinomatous Stomach ....	193
<i>Erik Godtfredsen</i> (København): Malignant Nasopharyngeal Tumours Manifesting Themselves as Parotid Tumours .....	205
<i>K. A. Hultborn</i> (Stockholm): Treatment of Cancer of the Colon .....	215
<i>Olof Johansson</i> (Gefle): 200 Fälle von perforierenden Magen- und Duodenalgesehwüren .....	233
<i>K. A. Hultborn</i> (Stockholm): On Spontaneous Complete Discharge of Stones from the Gallbladder and Common Duct .....	260
<i>Hroar Haldbø</i> (København): Drainage in Operations on the Bile Passages .....	265
<i>Gösta Jönsson</i> (Eksjö): A New Method of Treating Capillary Haemangiomas ....	275
<i>Ivar R. Sandberg</i> (Stockholm): Postoperative Emptying Difficulties in Direct Connection with Gastric Resection .....	285
<i>Malle Brunk</i> (Lund): A Case of Aseptic Necrosis of the Patella .....	291
<i>Henrik Lagerlöf</i> (Stockholm): Choledochal Denervation on Biliary Dyskinesia ....	297
<i>K. R. Inberg</i> (Helsinki): Centrizing Intestinal Tuberculosis and Allied Conditions	307
<i>Gustaf Petré</i> n (Lund): Über die verschiedene Frequenz der Appendektomien auf Grund unsicherer oder unrichtiger Diagnose akute Appendicitis in den Jahresberichten verschiedener Krankenhäuser .....	327
<i>Sv. Quist-Hanssen</i> (Oslo): Supplement to: Caput Necrosis after Traumatic Dislocation of the Hip Joint in 4-year-old Boy .....	344



<i>Sv. Quist-Hanssen</i> (Oslo): Avascular Necrosis of the Femoral Head after Central Dislocation Fracture of the Hip Joint and after Isolated Fracture of the Greater Trochanter .....	347
<i>Oddmund Koller</i> (Bergen): Acute Interstitial Pancreatitis Provoked by Haemolytic Streptococci in Infected Food (Fish) .....	358
<i>A. Langenskiöld</i> (Helsinki): Normal and Pathological Bone Growth in the Light of the Development of Cartilaginous Tissue in Chondrodysplasia .....	367
<i>Sten Grettve</i> (Uppsala): A Contribution to the Knowledge of Primary True Concrements in the Small Bowel .....	387
<i>Gunnar Blix</i> (Uppsala): Chemical Investigation of the Enterolith in Grettve's Case and a Report of a Further Case of a Primary Calculus of the Small Intestine .....	411
<i>Henrik O. Lagerlöf</i> (Stockholm): Effect of Pentaerythritetranitrate on Pain ....	414
<i>Seante Annersten</i> (Uppsala): Studies on the Scalenus Anticus Syndrome .....	419
<i>Kaare Liavaag</i> (Oslo): Surgical Treatment of Pericarditis Constrictiva .....	440
<i>Erik Moberg</i> (Göteborg): Subcutaneous Rupture of the Tendon of the Tibialis Anterior Muscle .....	455
<i>Rudolf Brandberg</i> and <i>Tore Ekblom</i> (Stockholm): Cancer of the Colon and a Detail of Operative Technique .....	461
<i>Hugo Aronsson</i> (Stockholm): The Technique in Transarticular Nailing Arthrodesis in the Hip-Joint .....	475
<i>Bengt Nylén</i> (Uppsala): Anuria Observed in Connection with Penicillin Therapy .....	483
<i>Lars Thorén</i> (Uppsala): Intratracheal Goitre .....	495
<i>Carl Hirsch</i> (Stockholm): Synovectomy in Cases of Chondromalacia of the Patella .....	513
<i>Leif Ejskind</i> (Oslo): A Clinical Study of the Hematological Changes in Acute Obstruction of the Small Intestine .....	519
<i>Erik Unonius</i> (Kärsta): Local Penicillin Treatment of Suppurative Infection in the Tendon Sheath .....	532
<i>Eino E. Vuori</i> (Loimaa): Two Cases of Incarceration in a Defect in the Mesentery of the Small Intestine .....	541
<i>Eino E. Vuori</i> (Loimaa): A Clinical and Pathological Anatomical Study of Tumours of the Kidney in Children, Based on a Series of 18 Cases.....	555

## List of Authors.

- Annersten, S. 419  
Aronsson, H. 475
- Blix, G. 411  
Brandberg, R. 461  
Bruuk, M. 291
- Candolin, Y. 61
- Efskind, L. 81, 519  
Ekblom, T. 461  
Ericsson, N. O. 167
- Faber, B. 96
- Godtfredsen, E. 205  
Grettve, S. 387
- Hahn, B. 76  
Haldbo, H. 265  
Hellstadius, A. 31, 156  
Hirsch, C. 513  
Hultborn, K. A. 215, 260
- Inberg, K. R. 307
- Jerre, T. 1  
Johansson, O. 233  
Jönsson, G. 275
- Kapel, O. 27, 54, 132, 137  
Koch, F. 145  
Koller, O. 358
- Lagerlöf, H. 297, 414  
Langenskiöld, A. 367  
Liawaag, K. 440
- Moberg, E. 455
- Nylén, B. 483
- Petrén, G. 327
- Quist-Haussen, Sv. 344, 347
- Sandberg, I. R. 285  
Sandblom, Ph. 76  
Schildt, E. 101  
Schroeder, E. 17
- Tønnesen, H. 96
- Unonius, E. 532
- Wahren, H. 193  
Vuori, E. 541, 555